US Army Corps
of Engineers
Kansas City District

Engineering and Construction Division
Hydrologic Engineering Branch

Water Control Section

Annual Report of Reservoir Regulation Activities

Summary for 1999-2000

December 2000

MISSOURI RIVER DIVISION, KANSAS CITY DISTRICT
SUMMARY OF LAKE REGULATION ACTIVITIES
AUGUST 1, 1999 TO JULY 31, 2000

TABLES

PLATES

APPENDICES

PURPOSE AND SCOPE.

This report summarizes the past year's regulation activities at reservoir storage projects operated for flood control under the direction of the Corps of Engineers and within the boundaries of the Kansas City District, and it outlines briefly the programs proposed for the year ahead. Topics discussed in the report include climatology, project accomplishments, current project operations; major regulation problems and proposed solutions; lake regulation manuals; data collection programs and procedures; ongoing studies, and personnel of the Water Control Section, Kansas City District, Corps of Engineers. The reporting period primarily covers the operating year from August 1, 1999 through July 31, 2000, with additional discussion on proposed operation and studies programmed through calendar year 2001. Preparation of this report is in conformance with paragraph 13b of ER 1110-2-240, dated October 8, 1982.

LAKES IN THE KANSAS CITY DISTRICT.

The Kansas City District of the Corps of Engineers includes the watershed of the Missouri River from Rulo, Nebraska, (mile 498.1 above the mouth) to the junction of the Missouri and Mississippi Rivers near St. Louis, Missouri. During the period covered by this report, 29 storage projects at which the Corps has either complete or partial water control responsibility were in operation within the District. The location of each lake and reservoir in the District is shown on Plate 1, and a summary of engineering data outlining the physical characteristics of each project is included as Plates 2A through 2E.

PROJECT FUNCTIONS AND GENERAL PLAN.

Functions served by storage facilities in the Kansas City District include: flood control, irrigation, water supply, low flow and navigation supplementation, water quality, hydroelectric power, recreation, and fish and wildlife. With the exception of flood control and a portion of the fish and wildlife program, the functions listed above are normally provided through the regulation of storage contained in the multipurpose pool. The storage space in the flood control pool is regulated primarily for flood control, although storage release schedules may be modified at times to serve other uses such as fish and wildlife enhancement and navigation flow supplementation when flood control storage occupies only the lower portion of the flood control pool. Releases from multipurpose storage are controlled by the manipulation of gates or other means in accordance with plans, schedules, and rule curves prepared in advance to meet various conditions of inflow, water demand, and downstream channel conditions. The general plan for regulation of flood-control storage is to evacuate all accumulations in flood-control space as rapidly as downstream channel capacities and flow conditions permit. Should the top of flood pool be exceeded, criteria have been developed for each project that schedule releases with an aim toward safeguarding the structure. Downstream interests are warned of the possibility of flooding should a surcharge operation appear likely. During this report period, minor deviations from the general plan were permitted at some lakes as water was deliberately accumulated in the flood-control pools for fish and wildlife enhancement and protection of water supplies during the drought. Additional details about these deviations and the use and regulation of the "dual-purpose" storage are presented in other sections of this report.

CLIMATOLOGY.

The early part of 1999 was relatively moist and mild across the District, except for dryness in the western portions of Kansas and Nebraska. Runoff to both the mainstem Missouri River and most District lakes had been normal to above normal, with high pools occurring in May through early July. By late July through early September, the entire District turned drier and warmer than normal, the beginning of a yearlong drought period. Western Kansas and Nebraska experienced some locally intense storms in August. Temperatures returned to normal in late September, but October was particularly dry. Moderate drought as defined by Palmer drought indices began to build first in northern Missouri and then extended throughout the District by December. High pressure dominated climatology in the central plains the rest of the winter, and the temperatures rarely got any colder than in October and November. Overall, temperatures across the District averaged 3-5 degrees above normal during the winter. Eastern Kansas and Missouri received some rain and snow in November and December 1999, and most of the District received normal precipitation from mid-February through mid-March, 2000.

April and May 2000, continued generally warmer than normal, and most of the District turned very dry. April 2000 was the driest April on record in Kansas City and for the state of Missouri. By May, drought conditions had become severe in far eastern Kansas and Nebraska, southern Iowa, and northern Missouri. A few storms moved through Kansas City and areas to the south beginning in mid-May. Stormy periods spread to the rest of the District by mid-June. The weather remained changeable through late July, with periods of very warm temperatures and timely rainstorms. Missouri particularly benefited from the rains, alleviating most of the drought conditions in that state. Temperatures for the summer were closer to normal with some hot spells. Despite the July rains, precipitation generally continued below normal for the summer, with the wettest areas to the south. The fall of 2000 was again warm and generally dry, with mid-August to mid-September hot, and drought reintensified in northern Kansas, eastern Nebraska, and western Iowa. The Midwest weather began to change to a cooler and wetter pattern in October 2000, and cold weather developed during the subsequent winter.

For the calendar year 1999, the average temperature across the District was about the 10th warmest for the last 100 years. Precipitation was about normal, but most of it occurred in the early part of the year prior to the current reporting period. For the calendar year 2000 through November, preliminary figures indicate that the year has been among the five warmest on record across the District. Total precipitation was just a little below normal except for some dry pockets in north central Kansas and eastern Nebraska.

However, the rainfall totals are deceptive since there were very few flooding rains, and District stream flows for the reporting period were much below normal. District lakes began the reporting year in August 1999 with close to normal pools due to good carryover storage from the wet spring in 1999. But many struggled to refill to their normal summer levels in 2000. Milford and Rathbun Lakes did not refill to their multipurpose levels until early July. Long Branch and Stockton Lakes did not refill at all. At the end of the summer and this reporting period, most Corps lakes began slipping below their normal pool levels despite the beneficial rains in June and July. Most Reclamation projects did not refill during

the spring of 2000 due to high irrigation demands during both 1999 and 2000 and the low runoff through the year 2000.

In April 2000, Missouri and Iowa activated their state drought committees, followed by Kansas and Nebraska in May and June. The District Emergency Management Office provided representatives to the Kansas and Missouri committees and some technical assistance. Nebraska and Iowa requests for assistance at Kansas City District projects in their states were coordinated through sister District offices. For instance, the Rock Island District representative assisted the State of Iowa in a request for special operations at Rathbun Lake. However, the primary impact of the first-year drought conditions was to local water supplies dependent on very low flows in smaller rivers and streams. By the end of the year, most of these problems had been resolved. No emergency water supplies were needed from District lakes.

PROJECT ACCOMPLISHMENTS.

Operating purposes at storage projects in the Kansas City District include flood control, irrigation, water supply, low flow and navigation supplementation, water quality, hydroelectric power, recreation, and fish and wildlife. Project accomplishments in each of these functional areas, for the period covered by this report, are described briefly in the following subparagraphs.

Flood Control.

Stream flow regulation by storage projects in the Kansas City District began with the closure of Kanopolis Lake in February 1948. By July of that year, Kanopolis also provided the first flood control storage, benefiting downstream damage centers. Since this initial impoundment, stream flow regulation by Kansas City District's lake projects has produced flood reduction benefits estimated in the millions of dollars annually. In addition to the Corps of Engineers lake projects, local protection projects in the form of levees, flood walls, and channel improvements also have provided flood reduction benefits amounting to millions of dollars. Federal and private agricultural levees along with temporary storage of flood flows in the main stem reservoir system above Sioux City, provide additional benefits within the District. Flood reduction benefits during fiscal year 2000 (October 1, 1999, through September 30, 2000) credited to all District Corps of Engineers lake projects were $2,927,000. This total is among the lowest annual totals in the history of the District, due to the drought conditions. When the additional benefits from

Table 1: Flood Reduction Benefits
October 1, 1999 through September 30, 2000

Project	Fiscal Year	Cumulative
Clinton Lake, KS	$4,000	$793,381,000
Harlan County Lake, NE	$21,000	$148,071,000
Harry S Truman Resv., MO	$0	$1,836,645,000
Hillsdale Lake, KS	$0	$30,719,000
Kanopolis Lake, KS	$2,657,000	$1,154,651,000
Little Blue River Lakes, MO	$0	$50,813,000
Long Branch Lake, MO	$0	$44,918,000
Melvern Lake, KS	$0	$147,428,000
Milford Lake, KS	$13,000	$921,071,000
Perry Lake, KS	$8,000	$4,005,374,000
Pomme De Terre Lake, MO	$0	$65,572,000
Pomona Lake, KS	$0	$151,276,000
Rathbun Lake, IA	$0	$141,098,000
Smithville Lake, MO	$45,000	$485,384,000
Stockton Lake, MO	$0	$200,339,000
Tuttle Creek Lake, KS	$167,000	$3,901,795,000
Wilson Lake, KS	$12,000	$1,336,286,000
TOTALS	**$2,927,000**	**$15,414,821,000**
Oct 1, 1998, to Sep 30, 1999	**$2,566,008,000**	**$15,411,894,000**
10-Year Average (1991-00)	**$1,252,878,727**	

levees, the main stem reservoirs, and the regulation of flood control storage in the Bureau of Reclamation projects in the District are included, flood reduction benefits in the District totaled $6,523,000. Table 1 lists the flood control benefits attributable to the Corps of Engineers lake projects in the District. The cumulative total has been recomputed in this year's report to account for an error in the cumulative total in last year's report.

Irrigation.

Carryover storage at Bureau of Reclamation lake projects and the Corps Harlan County Lake was generally near or above normal at the end of the 1998 irrigation season, except for a little below normal carryover at Swanson and Harry Strunk Lakes and Bonny, Enders, and Lovewell Reservoirs. Precipitation at the project dams during 1999 ranged from 69 percent of normal at Lovewell Dam to 126 percent of normal at Enders Dam. The 1999 inflow was above the dry year forecast at all of the Reclamation reservoirs with the exceptions of Enders and Lovewell Reservoirs. At the beginning of the 1999 irrigation season, only Enders Reservoir did not have sufficient storage to provide water users with a full water supply. A dry and warm summer 1999 led to high irrigation demands that significantly reduced storage in most reservoirs. However, timely rainfalls in August 1999 reduced demands at some projects. Carryover storage at the end of the 1999 irrigation season was again near or above normal with the exception of Swanson Lake, Enders Reservoir, and Lovewell Reservoir. Total carryover storage at the irrigation projects was 1,060,000 acre-feet (AF) at the end of September 1999, compared to 1,042,000 AF at the end of September 1998.

The eleven Reclamation reservoirs in the Kansas River basin, plus the Corp's Harlan County Lake, provided 260,041 AF of irrigation water to 150,840 acres of project lands during calendar year 1999, the latest period for which final figures are available.

The State of Colorado makes Bonny Reservoir storage water available to Hale Ditch and other natural flow appropriators under short-term water service contracts. Most of the 700 acres served by Hale Ditch are now owned and operated by the Division of Wildlife, Colorado Department of Natural Resources. During 1999, at the request of the State of Colorado, 3,005 AF of water were diverted to Hale Ditch.

Municipal and Industrial Water Supply, and Water Quality Control.

Three municipalities and one rural water district have executed water service contracts for full or supplemental water supplies from three Bureau of Reclamation reservoirs. A contract with the City of Norton, Kansas, provides for a maximum annual usage of 1,600 AF from Keith Sebelius Lake (Norton Dam). A contract with the City of Beloit, Kansas, provides for a maximum annual usage of 2,000 AF from Waconda Lake. Waconda Lake also provides up to 1,009 AF of water for a contract with the Mitchell County Rural Water District No. 2. A contract with the City of Russell, Kansas, provides for a maximum annual usage of 2,000 AF from Cedar Bluff Reservoir.

During calendar year 1999, the City of Norton used 488 AF of municipal water from Keith Sebelius Lake. No storage releases were made from Waconda Lake for the City of Beloit; however, 4,800 AF was bypassed for water quality control as directed by the Kansas State Water Commissioner. Releases of 655 AF of water were made to the Mitchell County Rural Water District

No. 2 from Waconda Lake. No releases were made from Cedar Bluff Reservoir for the City of Russell. The State of Kansas used the fish hatchery below Cedar Bluff Dam for nurturing Canadian Geese. Approximately 416 AF of water were released from Cedar Bluff Dam in 1999 for use at the fish hatchery.

Water supply contracts for lake storage space, annual withdrawals, or surplus water also exist between the Corps of Engineers and the State of Kansas and 12 other municipalities and rural water districts within Kansas, Missouri, and Iowa. The State of Kansas in turn contracts with a large number of municipalities and industrial sites to supply water from their contracted storage space through the State water assurance and water marketing programs. To date, assurance districts have been formed for the Kansas River and the Marais des Cygnes River users. Water is supplied within the limits of each contract through designated lake releases or from intakes located on the lake at the following projects: Kanopolis, Milford, Tuttle Creek, Perry, Clinton, Melvern, Pomona, Hillsdale, Smithville, Longview, Rathbun, Long Branch, Stockton, and Harry S. Truman. Most of the municipalities and rural water districts holding contracts with the Corps utilize the available water annually.

The drought conditions in 2000 resulted in releases from Kansas State contracted water supplies at Milford for the first time since the early 1990's, and from Tuttle Creek, Perry, Melvern, and Pomona for the first time since the Assurance Districts were formed. Beginning in June 2000, the Kansas Water Office requested additional releases of up to 50 cubic feet per second (cfs) from Milford Lake for a downstream water marketing contract holder. Beginning in May 2000, the Kansas Water Office requested additional releases of up to 35 cfs from Pomona Lake for the Marais des Cygnes Water Assurance District No. 2. The Kansas Water Office also requested an additional release of 25 cfs from Melvern Lake for a brief period in August 2000 for the same purpose. Later in the fall of 2000, the Kansas Water Office requested large additional releases from Milford, Perry, and Tuttle Creek Lakes for the Kansas River Water Assurance District No. 1. In late May 2000, the Kansas Water Office also requested that the Corps make additional releases from Harlan County Dam to supplement flows on the lower Republican River. Since flow supplementation is not an authorized purpose at Harlan County Lake, the Corps denied this request.

Recommendations for minimum stream flows to benefit stream sanitation and for the maintenance of desirable water quality standards were originally established by the U.S. Public Health Service for many river reaches below proposed dams in the Kansas City District. These recommendations were then utilized to establish minimum release requirements for many of the District reservoir projects. In some cases, specific water quality storage allocations were included in the project planning to increase the reliability of the minimum flow releases. Depending on the project, the amount of the minimum releases may be constant through the year, or it may vary seasonally or vary depending on the amount of current lake storage. Minimum releases for the purposes of downstream quality control and stream sanitation range from 3 cfs during the winter months at Hillsdale Lake to 100 cfs at Tuttle Creek Lake. Large minimum flow releases during certain seasons are also included in the water level management plan for Pomme de Terre Lake and in an agreement with the State of Missouri at Truman Lake. Flows were reduced below minimum requirements for brief periods due to construction, periodic inspections, or emergency operations at some projects. Seepage is generally considered sufficient to meet minimum flow requirements downstream at most Reclamation dams. Additional

releases are made from Tuttle Creek, Milford, and Perry Lakes for water quality purposes during periods of low flow on the Kansas River.

Navigation.

Releases from the Missouri River main stem reservoir system are designed to provide equitable service to navigation and other project purposes, while at the same time recognizing the important flood control functions of the system. Navigation on the Missouri is limited to the ice-free season, with a full season normally extending from April 1 to December 1 at the mouth. Operating experience plus numerous studies have indicated that flows of 35,000 cfs at Kansas City are the minimum that will permit navigation. Groundings can occur with flows of that magnitude, and dredging is often required to alleviate local problems. Therefore, an additional flow of 6,000 cfs above the minimum target has been set as the "full service" level for the navigation function. Thus, a full-service target flow of 41,000 cfs at Kansas City is considered adequate to maintain the designed 9-foot by 300-foot channel with little or no dredging.

In normal times, power releases from Gavins Point Dam on the Missouri River above Omaha, plus local inflows between Gavins Point and Kansas City, keep navigation flows at the full service level through the reach from Kansas City to the mouth. In years of excess water supply, releases greater than those needed to maintain full service navigation requirements are made from the main stem reservoirs to evacuate flood control storage accumulated in the spring and early summer. When an abundance of water is available, the season is often extended an additional 10 days at the end of the season, ice conditions permitting. The decision to extend the season is based on both main stem reservoir system storage and forecast annual basin runoff, the guidelines for which are described in the Missouri River Basin Master Manual. The 1999 runoff for the Missouri River above Sioux City was 31.7 million acre-feet (MAF), or 126% of the normal 25.2 MAF. This continued a trend of high annual runoffs through most of the 1990's, and again the 1999 navigation season was extended an additional 10 days.

Releases for navigation supplementation from Kansas River basin lakes are not required when basin runoff is normal or higher than normal, as it has been in recent years. No supplementation was required from Kansas lakes in 1999. However, during years of below normal water supply, Kansas lakes are at times called upon to supplement Missouri River flows below Kansas City in order to meet the navigation requirement and to conserve water in the main stem lakes. The decision to make supplementation releases usually occurs when the local natural inflow from Nebraska City to Kansas City (including the Kansas River) is less than 4,000 cfs. Guidelines for navigation supplementation releases are contained in existing project and basin water control manuals.

In 2000, the main stem reservoir system began the navigation year with normal system storage and an expectation of slightly lower than normal annual inflows. Based on the Master Manual guidelines, the Omaha Reservoir Control Center determined that there would be a normal length navigation season with full service support from Gavins Point releases. But by July system storage had dropped below normal, and the continuing drought led to dramatically lower basin runoff forecasts. The Master Manual provides for a reevaluation of navigation support in early July. Based on conditions at that time the Reservoir Control Center determined that the navigation flow support would be reduced

by 1,500 cfs, resulting in a target flow of 39,500 cfs at Kansas City instead of the full service support level of 41,000 cfs. Later in July and August low natural inflows from Nebraska City to Kansas City might have resulted in a decision to supplement Missouri River flows with releases from Kansas basin lakes, but releases were restricted due to special operations for endangered and threatened bird species along the Kansas River. These operations were required under the Endangered Species Act and took precedence over navigation supplementation releases. After the end of the nesting season in late August, Tuttle Creek Lake releases were increased first to evacuate excess flood control storage and then to supplement Missouri River flows. However, the releases were terminated in September in accordance with a judicial temporary restraining order obtained by the State of Kansas. The deficit in Missouri River flows was then met by increasing Gavins Point releases.

Hydropower.

Normal operation of the Stockton hydroelectric facility consists of peaking power generation at a rate of 40 to 45 megawatts for a period of 6 to 10 hours daily throughout the workweek. Releases scheduled for the Harry S. Truman hydroelectric plant anticipate peaking power generation primarily during the months of June through September, with additional generation at other times of the year as water is available and there is a need. The maximum peaking generation rate at Truman is about 180 megawatts, but due to downstream channel capacity limitations only about four units with a capacity of 120 megawatts are normally operated for extended periods.

The generating unit at Stockton overheated on July 1, 1999, and it was shut down for an extended period for repairs. During the shutdown, the spillway was used along with the low flow bypass to evacuate storage in the flood pool. The unit was brought back into service on September 15, 1999. The unit will again be taken down for an extended period in 2001 to repair cavitation damage on the turbine blades. Stockton's power operation continues to be restricted by downstream channel capacities that limit tailwater elevations to 777.0 feet and Highway "J" stages to a maximum reading of 17.5 feet. Net generation by the Stockton plant during this report period August 1999 to July 2000 totaled 15,423 megawatt-hours. This is only about 24 percent of the total for the previous reporting period, due primarily to the continuing drought and low reservoir inflows.

At the Harry S. Truman power plant, five of the six units are normally available for power generation. Annual maintenance and unscheduled outages often result in one or more units out of service at any one time. Unit 1 was brought back into service on December 1, 1999, after being down for a major overhaul since late 1993. An interim operation plan for Truman was negotiated and approved between the Corps, the State, and the Southwestern Power Administration, effective March 1990. Power generation releases at Harry S. Truman are now restricted to four units during the week and three units on weekends between Memorial Day and Labor Day. During the period December through February, five units may be operated during the weekdays (total time limited to 600 hours per year) and three units on weekends. The tailwater elevation measured at the Highway 7 bridge at Warsaw is limited to 662.5 feet, Union Electric datum, during five-unit releases from the power pool. When the Truman pool level elevation is above 710.0 feet, a minimum of one unit is operated continuously. Net generation by the Truman plant during this report period August 1999 to July 2000 totaled 82,105 megawatt-hours. This is only about 14 percent of the previous reporting year total.

Under the interim agreement, Southwest Power declared a power emergency on July 20, 1999 due to high peak power needs during a hot weather period combined with the loss of five generating units at other Corps projects. The emergency was terminated on September 23, 1999. During the emergency, the Corps agreed to make all units at Truman available with certain restrictions. Southwest Power used five units on July 20, 23, 29, 30, and August 12 and 18. No adverse downstream conditions were reported to the District. During the period the minimum drawdown in the pool elevation was 704.99 feet, just one foot below the normal multipurpose pool elevation.

On May 18, 2000, Southwest Power requested that the Corps permit generation at Truman to six feet below the normal minimum power pool of 704.0. They also requested that inflows excess to generation requirements be stored in the Stockton and Truman flood pools when available. This request was related to the severe drought conditions and the probability of summer power shortages. The Corps denied the request as a routine scheduled operation due to adverse impacts on other project purposes. However, the Corps provided assurance to Southwest Power that they would cooperate to maximize power generation from Stockton and Truman if an imminent blackout or brownout situation appeared to be developing. This did not occur within the Southwest Power grid during the year 2000.

Recreation.

Recreational use of the Corps lakes is a highly visible and important function. Recreational use is enhanced when the lakes are operated close to their normal or multipurpose pool levels. During flood years when large quantities of water are stored in the flood pools and during drought years when the reservoir levels drop, then access to the lakes and the shoreline facilities, as well as the quality of the experience, is reduced. Park managers at the projects are also concerned about related factors such as facility maintenance and water quality. The fish and wildlife function is closely related to the recreation experience, and coordination with state and county park officials for park management is important. Projects close to metropolitan areas tend to experience the largest recreational demand. Fiscal year 2000 visitation figures compiled for the Corps lakes in the Kansas City District indicate an increase in visitation hours at ten of the 18 lake projects. Total visitation hours for the 18 projects are slightly more than the previous year, but fee collections were slightly less. A list by projects of the visitation totals at Corps lakes is shown in Table 2. Project park facilities at Blue Springs, Hillsdale, Long Branch, Longview, and Smithville are leased to county or state agencies. The fees collected at

Table 2: Visitation and Fee Collection
October 1, 1999 through September 30, 2000

Project	Visitation (Visitor Hours)	Recreational Fees Collected
Blue Springs Lake, MO	1,020,880	$0.00
Clinton Lake, KS	7,103,248	$108,848.25
Harlan County Lake, NE	7,006,524	$142,686.97
Harry S. Truman Resv., MO	10,531,867	$449,428.27
Hillsdale Lake, KS	1,931,380	$1,042.50
Kanopolis Lake, KS	1,768,680	$53,877.00
Long Branch Lake, MO	1,492,716	$185.87
Longview Lake, MO	2,182,793	$1,025.00
Melvern Lake, KS	6,594,948	$189,593.00
Milford Lake, KS	5,646,084	$128,593.48
Perry Lake, KS	6,018,153	$192,678.01
Pomme de Terre Lake, MO	16,967,508	$273,184.64
Pomona Lake, KS	3,035,556	$91,943.25
Rathbun Lake, IA	5,383,605	$242,886.08
Smithville Lake, MO	6,835,372	$557.50
Stockton Lake, MO	6,516,900	$326,770.82
Tuttle Creek Lake, KS	2,654,356	$11,345.00
Wilson Lake, KS	2,165,029	$95,776.50
TOTALS	**94,855,599**	**$2,310,422.14**
Oct 1, 1998, to Sep 1, 1999	**94,383,112**	**$2,361,187.64**
4-year Average (1997-2000)	**95,829,370**	**$2,249,697.20**

those projects are only for national passes such as the Golden Age Passport. Blue Springs Lake does not have a fee collection office.

Fish and Wildlife.

Water level management plans, which include the fluctuation of pool levels at various times of the year for the enhancement of fish and migrating waterfowl, are proposed by the respective state resource agencies annually for most Corps and Reclamation projects. The proposals generally include a winter drawdown from higher fall levels to reduce ice damage along shorelines and to provide buffer space for spring rains, a slow spring rise to enhance fish spawning, a summer level for recreation, and a higher fall level to benefit waterfowl habitat and hunter access. In Kansas the coordinating agency is the Kansas Water Office, in Missouri the coordinating agency is the Department of Conservation, and in Iowa the coordinating agency is the Department of Conservation, and in Iowa the coordinating agency is the Department of Natural Resources. When evaluating the proposals, consideration is given to the impacts of the proposal on other project purposes including flood control, water supply, water quality, and recreation. Water level management plans are treated as deviations, with approval required from the Division office. During the August 1999 to July 2000 reporting period, water level management plans were only approved for selected lakes in Missouri, including Smithville, Pomme de Terre, Stockton, and Long Branch. Plans for Corps and Reclamation lakes in Kansas were last approved for water year 1999. A plan for Rathbun in Iowa was last approved for the calendar year 1999, but low inflows prevented the fall rise portion of the plan. During July 2000, the Division office approved a deviation to allow Kirwin, Webster, Waconda, Norton, Kanopolis, Milford, Clinton, Pomona, Melvern, and Hillsdale lakes in Kansas, and Smithville and Pomme de Terre lakes in Missouri to be operated at either slightly higher than normal summer levels and/or to begin filling to the fall levels anticipated to be approved for the 2000-01 plan proposals. One of the reasons for the approval was the drought conditions existing in 2000 and the possibility that fall inflows would be insufficient to provide a normal fall rise in the pools. Only Smithville and Kanopolis actually received sufficient inflows to provide a fall rise in 2000.

Special reservoir release operations required under the Endangered Species Act are described in the next section. These are not part of the existing water control plans.

PROJECT OPERATIONS.

Actual operations for the 1999-2000 reporting year and the proposed operations through calendar year 2001 are discussed briefly in the following subsections.

Corps of Engineer Lakes - August 1, 1999 through July 31, 2000.

With the exception of special operations required under the Endangered Species Act, Corps projects within the Kansas City District were regulated in accordance with normal procedures during the period covered by this report. Appendix A includes pool elevation hydrographs at all Corps projects in the District, along with summary data providing an historical perspective.

During the past reporting period from August 1999 to July 2000, the District experienced slightly below normal rainfall in most months, following a wet spring in 1999. At the beginning of the reporting period on August 1, 1999, nine Corps lakes had storage in the flood pools with Stockton containing 13 percent and Rathbun and Tuttle Creek 5 percent each. At the end of the period on July 31, 2000, eleven Corps lakes had some flood control storage. Tuttle Creek storage occupied 9 percent of its available flood control space, Kanopolis contained 6 percent, and Pomme de Terre contained 5 percent. However, most pools lost storage during the fall, and by the end of the year the Tuttle Creek pool elevation had dropped 17 feet and virtually all of the flood control storage in other reservoirs had been released. None of the Corps or Reclamation lakes in the District experienced record high pools during this reporting period. Due to continuing drought conditions, Long Branch Lake dropped to a record low elevation of 785.06 on June 10, 2000, or about 6 feet below the full multipurpose pool level. Continued dry conditions in the fall and winter of 2000 were resulting in even lower elevations. Blue Springs Lake also reached a record low elevation of 800.10 on December 14, 1999. However, this was due to a decision to lower the lake two feet below the normal pool level of 802.0 for shoreline weed control.

Operations at Tuttle Creek Lake during the summer of 2000 were affected by the presence of two bird species, the Piping Plovers and Least Terns, listed on the Federal Threatened and Endangered Species List, respectively. The Act requires Federal agencies to ensure that their actions do not jeopardize the continued existence of a threatened or endangered species. The District contracted with Dr. Roger Boyd of Baker University in Baldwin, KS, to monitor their nesting activities. The District's Environmental Resources Section administered the contract and provided coordination with other agencies, including the U.S. Fish and Wildlife Service. Water Control in turn coordinated release decisions with personnel in Environmental Resources Section and other Corps elements. Nests were initially observed on the Kansas River in the Wamego to Topeka reach in late May 2000. Lake operations were restricted by reducing the target stage at Wamego to about 5 feet in an attempt to avoid adversely impacting the nesting of these Federally-listed species. This was considerably less than the 8-foot target stage in 1999, limiting the maximum discharge at Tuttle Creek to about 3,000 cfs. Releases were reduced on numerous occasions when stormy weather developed. A storm on July 4 resulted in the loss of two nests due to uncontrolled inflow below Tuttle Creek, but overall the operations were successful in maintaining the river flows below the target levels at Wamego. Restrictions on Tuttle Creek releases were terminated on August 26. Tuttle Creek Lake stored a substantial amount of water in its flood pool during the summer, with the pool elevation rising to 1086.4

(multipurpose pool level 1075.0) in late July. Substantial contract costs might have been incurred if the pool had risen above an elevation of 1091, due to an ongoing gate maintenance contract. Only a minor amount of water was stored in the Milford Lake flood control pool. Operations at Perry and Clinton Lakes were not affected.

After the termination of the special operations for nesting, Tuttle Creek releases were transitioned into normal operations by evacuating excess flood control storage and providing supplemental releases for Missouri River navigation and the Kansas River Water Assurance District. These operations were described in previous subsections specific to navigation and water supply.

Water Control personnel participated on District drought response teams in 2000. Emergency Management coordinated the teams. Water Control personnel were occasionally called upon to meet with the State of Missouri Drought Assessment Committee, and they provided coordination with representatives from sister Districts who attended state committee meetings in Iowa and Nebraska. On June 15, the Rock Island District assisted in a request from the State of Iowa Drought Advisory Council to hold up to two feet of water in Rathbun Lake above its normal multipurpose pool level. This was approved as a Water Control deviation request by the North Pacific Division office, effective through the end of the year. Later in the year in August and September, Water Control personnel assisted the District drought team members in coordinating postponing periodic inspections at Tuttle Creek and Milford due to water supply concerns. The Milford postponement was due to water supply concerns at Junction City. Other drought related actions included supplemental releases from contract water supply storage at a number of projects at the request of the State of Kansas. As noted earlier, the District denied a request from the State of Kansas for additional releases from Harlan County Lake to supplement flows on the lower Republican River. The District also denied a request from Southwest Power Administration for additional storage and releases at Truman and Stockton projects that would have benefited power operations.

Dam safety was a prominent issue during this reporting period. Beginning in 1999 and continuing through 2000, the Emergency Action Plans for all Corps lake projects are being revised. All revisions will be distributed to the projects by early 2001. These are updates of the Contingency Plans last released in the late 1980's. Water Control personnel participated on some field and desktop exercises for the revised plans. They also participated in a dam safety training session at Rathbun and Long Branch Lakes in November 1999 and another one at Milford and Tuttle Creek Lakes in March 2000. Section personnel are also participating in a hydrologic adequacy study for the spillway at Tuttle Creek Lake. The Tuttle Creek Dam Safety Assurance Study includes a seismic evaluation. At Wilson Dam, movement has been noted in the stilling basin walls. The movement led to a decision to temporarily remove a portion of the backfill behind the walls. Further repair work is awaiting funding. An analysis of the Harlan County Dam tainter gates and bearings indicates that inadequate trunnion friction values were used in their design. There are also problems with the chain hoists. In addition, there is a potential for upstream failure of Bureau of Reclamation dams. Repair work is awaiting funding.

Bureau of Reclamation Projects - August 1, 1999 through July 31, 2000.

Reservoir operations at the 11 Bureau of Reclamation projects in the Kansas City District were carried out in accordance with normal regulation procedures during the period covered by this report. At the Reclamation projects, all operations are scheduled for optimum benefits of the authorized project functions. Monthly, or as often as runoff and weather conditions dictate, Reclamation evaluates the carryover storage and estimated inflow at each reservoir to determine whether excess water is anticipated. If excess inflow is apparent, controlled releases are made to maximize the downstream benefits, including flood control.

The regulation of flood control storage in Reclamation reservoirs in the Kansas River basin has been assigned to the Kansas City District, Corps of Engineers. When inflows are sufficient to produce an encroachment into the flood pool, coordination is immediate between the two Federal agencies, and decisions are made regarding the regulation desired. Regulation orders are issued by the Corps, received by Reclamation's Water Operations Group at the McCook Field Office in Nebraska, and then forwarded to the Reservoir Superintendent at the project. The Operations Group in McCook is responsible for issuing orders for the conservation releases directly to the Reservoir Superintendent. Appendix B includes pool elevation hydrographs at all Reclamation projects in the District, along with summary data providing an historical perspective. During this reporting period, there was minimal flood control storage accumulated at Reclamation projects due to the drought. As in the previous reporting year, minor flood control releases were needed from Cedar Bluff Lake, an unusual occurrence.

Details of the 1999 irrigation operations at Reclamation lakes are described in the earlier section on Irrigation. Carryover storage from the 1999 irrigation season was near or a little above normal at Reclamation projects in central and eastern Kansas and Nebraska, but less than normal at Swanson, Enders, and Lovewell reservoirs. Inflows going into the 2000 irrigation season were generally less than normal, but at the beginning of the year 2000 irrigation season, Reclamation expected that under the most likely inflow conditions the water supply storage would be adequate at all Reclamation reservoirs in Kansas City District except Enders Reservoir.

As at the Corps projects, the Safety of Dams program has been an important concern at Reclamation projects the last couple years. Emergency Action Plans were updated and associated exercises were conducted at all projects in 1998 and 1999. Emergency radios were installed at each of the projects as a backup communication system to contact local emergency management officials during emergency events. Repair work on an embankment slough was completed at Cedar Bluff Dam, and new instrumentation was added to Enders Dam and repairs to the spillway approach apron were completed. Repairs were also made to the Medicine Creek Dam (Harry Strunk Lake) river outlet works stilling basin and the Lovewell Dam spillway floor. In addition to normal maintenance, Reclamation has also been working with the irrigation districts to implement water conservation measures and improve canal distribution efficiencies.

Proposed Operations - August 2000 Through Calendar Year 2001.

Corps and Bureau of Reclamation storage projects in the Kansas City District contained a total of 5,581,827 AF of storage on August 1, 2000. This total is 75,991 AF less than the volume in storage on this date one year earlier, mostly due to high irrigation demand and low inflows at the Reclamation

projects. Of the total volume in storage, 740,327 AF (13 percent) were contained in the Bureau of Reclamation's lakes and 4,841,500 AF (87 percent) were contained in the Corps' projects. The total storage in the Bureau of Reclamation lakes is a decrease of 73,780 AF in storage compared to August 1, 1999, one year earlier.

Eleven of the Corps lakes and one of the Reclamation lakes in the District contained storage in their flood control pools on August 1, 2000, with the occupied storage amounting to 314,440 AF. This volume compares to 292,150 AF of flood control storage space occupied on August 1, 1999. At both points in time, a large portion of the system flood control storage was accumulated in Tuttle Creek Lake due to release restrictions needed to reduce damage to downstream nesting sites (see the earlier section describing current year operations at Corps projects).

The water service contracts for nine irrigation districts in the Nebraska-Kansas Projects area were to expire between 2000 and 2007. Some of these are contracts that were extended temporarily in accordance with a law passed in 1996. The long-term water service contracts with the Frenchman-Cambridge, Kansas Bostwick, Bostwick in Nebraska, Frenchman Valley, and Almena Irrigation Districts were renewed on July 25, 2000 and become effective on January 1, 2001. Reclamation is currently negotiating the renewal of long term service contracts with the Kirwin and Webster Irrigation Districts. Renewal of the contracts constitutes an action requiring the preparation of a National Environmental Policy Act (NEPA) compliance document.

The Northwest Division Commander signed a Record of Decision dated July 25, 2000, for the Corps' Harlan County Lake in Nebraska adopting Reclamation's Final Environmental Impact Statement for the Republican River Basin Repayment and Long-Term Water Service Contracts. Reclamation signed its Record of Decision on July 22, 2000, and the revised contracts with the irrigation districts were signed on July 25th. Harlan County Lake was constructed and operated for flood control, recreation, water quality, fish and wildlife, and irrigation. A substantial portion of the multipurpose pool is allocated to the irrigation function. The signing of the ROD's resolved an issue between the Corps and Reclamation regarding operation of the irrigation and sediment storage in the pool dating back to the early years of the project. The ROD's provide a plan that protects all project purposes affected by the declining water resources. The Kansas City District has submitted to the Division revisions to the Harlan County Water Control Manual incorporating the agreement.

The District is considering a reallocation of 20,000 AF of multipurpose and flood control storage at Kanopolis Lake to water supply storage, in conjunction with a 2-foot pool raise. The 1999 Water Resources Development Act provides that the State of Kansas may purchase this storage under the favorable pricing terms included in a 1985 Memorandum of Understanding. The State would then contract with local users for water supply under terms of the State water assurance or water marketing program.

MAJOR REGULATION PROBLEMS AND PROPOSED SOLUTIONS.

During this reporting period, minor deviations from the approved water control plans for the Corps projects were obtained for some projects, primarily related to the drought conditions. In early July 2000, the Division confirmed a verbal approval for a deviation allowing Rathbun Lake to store up to two feet of water in the flood control pool, as a water conservation measure requested in June by the

State of Iowa. The deviation is effective through the end of calendar year 2000. In early August 2000, the Division confirmed a verbal approval for a deviation allowing additional storage during August and September at selected lakes in Missouri and Kansas, both for water conservation purposes and to allow a transition to normal fall operations. The deviation was in lieu of an annual water level management plan for the Kansas lakes. The deviation was effective through September 2000. No deviations were needed during this reporting period for flood control purposes.

Contemporary regulation concerns with the Kansas River led to a decision in 2000 to begin the development of a Kansas River Systems Model. The regulation concerns include managing releases for Least Terns and Piping Plovers as required under the Endangered Species Act, possibly modifying Kansas River operations to conform with recommendations included in a recent U. S. Fish and Wildlife Service Biological Opinion on Missouri River Basin operations, providing releases in the lower Kansas River for water quality and supplemental navigation flows while accommodating increasing water supply needs, and declining channel capacities and other changes in operating considerations for flood control. The urgency for a new study has increased in recent years as the demand for Kansas River water has increased. All of the storage now allocated for water supply has been contracted to the State of Kansas, and the state is seeking reallocation for additional storage at Kanopolis. Funding for the development of a Kansas River system model has been obtained for the 2001 fiscal year, and a team has been assembled to begin evaluating problems and reviewing possible solutions. Additional funding will be requested for future years. Completion of the modeling study may lead to an update of the Kansas River Basin Master Manual.

WATER CONTROL MANUALS.

This section serves to provide the information requested in paragraph 13c of ER 1110-2-240, dated October 8, 1982, regarding the status of water control manuals.

Table 3: Project Manual Status and Revision Schedule

Reservoir/Lake	Stream/River	Owner	Report Status	Submission Schedule
Nebraska				
Master Manual	Republican	CE	Updated final submitted to NWD for review 28 July 1977	
Harlan County	Republican	CE	Approved by NWD 20 August 1973	
Harry Strunk	Medicine Creek	BR	Approved by NWD 12 July 1974	Dec 2001
Enders	Frenchman Creek	BR	Approved by NWD 26 March 1973	Dec 2001
Swanson	Republican	BR	Flood Control Regulation approved by OCE 6 Oct 69	Dec 2001
Hugh Butler	Red Willow Creek	BR	Flood Control Regulation approved by OCE 21 Nov 69	Dec 2001
Colorado				
Bonny	S. Fork Republican	BR	Approved by OCE 6 October 1969	Dec 2001
Kansas				
Lovewell	White Rock Creek	BR	Approved by OCE 9 April 1969 subject to comments	
Milford	Republican	CE	Approved December 1984. Minor revision approved Jan 95	
Norton	Prairie Dog Creek	BR	Approved 28 August 1974	
Master Manual	Smoky Hill	CE	Approved 28 March 1975	
Kanopolis	Smoky Hill	CE	Revision submitted to NWD 30 October 1984	
Cedar Bluff	Smoky Hill	BR	Approved by NWD 25 September 1975	
Kirwin	N. Fork Solomon	BR	Approved by NWD 6 February 1974	
Webster	S. Fork Solomon	BR	Approved by NWD 16 July 1975	
Wilson	Saline	CE	Revision submitted to NWD 13 June 1997	
Waconda	Solomon River	BR	Approved by NWD 12 July 1972	
Master Manual	Kansas	CE	Approved by OCE 22 March 1967 subject to comments	Sep 2005
Tuttle Creek	Big Blue	CE	Approved 16 April 1974. Minor revision approved Jan 95	
Perry	Delaware	CE	Approved July 1973. Minor revision approved Jan 1995	
Clinton	Wakarusa	CE	Approved 12 February 1980	
Master Manual	Osage River	CE	Appr by OCE 21 Sep 70 subject to NWD, OCE comments	
Pomona	110 Mile Creek	CE	Approved February 1973	Mar 2002
Melvern	Marais Des Cygnes	CE	Approved 27 June 1985	Mar 2002
Hillsdale	Big Bull Creek	CE	Approved 19 June 1985	Mar 2002
Missouri				
Pomme De Terre	Pomme De Terre	CE	Revision submitted to NWD September 1996	
Harry S. Truman	Osage	CE	Interim manual approved by NWD 12 May 1981, minor revision approved April 1996	
Stockton	Sac	CE	Approved 21 August 1975	
Smithville	Little Platte	CE	Approved 13 August 1979	
Long Branch	E. Fk Ltl. Chariton	CE	Interim manual approved 21 November 1978	
Longview	Little Blue	CE	Approved 15 February 1994	Mar 2002
Blue Springs	E. Fork Little Blue	CE	Approved 27 January 1994 subject to comments. Revision submitted to NWD Dec 1994	Mar 2002
Iowa				
Rathbun	Chariton	CE	Approved 19 October 1981	

Manual Status.

Water control plans prepared for specific projects and basins within the Kansas City District have been documented in appropriate manuals as directed by paragraph 6c of the above referenced ER. Paragraph 6c also directs that water control plans be revised as necessary to conform with

changing requirements resulting from developments in the project area and downstream, improvements in technology, new legislation, or other relevant factors, provided such revisions comply with existing Federal regulations and established Corps of Engineers policy.

The water control manual for Pomme de Terre was reviewed by the Missouri River Division and returned for corrections and clarifications on March 18, 1997. The water control manual for Wilson was submitted to the Missouri River Division for review on June 13, 1997. The schedule and status of manuals for all projects is shown on Table 3. The District has begun the development of a Kansas River Basin System Model. The need for the system model was described in the previous section on District regulation problems. A review of the model results may lead to a revision in the Kansas River Basin Master Manual.

Other Reports.

Plates 2A-E list project data showing the date impoundment of storage began, the date the multipurpose pool (the active conservation pool in USBR projects) first filled, and the current status of Standing Instructions for Regulation of Storage in Corps of Engineers Lakes.

As indicated in Engineering Manual 1110-2-3600, it is essential that project operators (dam tenders, power plant superintendents) at the various flood control and multiple-purpose reservoirs be supplied with regulation schedules to be followed in case of communication failure. These regulation schedules should be followed in case of communication failure with the headquarters from which instructions are normally issued during flood situations. Standing Instructions have not yet been issued for Truman Reservoir, Clinton, Hillsdale, Long Branch, Smithville, Longview, and Blue Springs Lakes.

HYDROLOGIC DATA COLLECTION - PROGRAM AND PROCEDURE.

The primary objectives of any hydrologic data program is to provide information on precipitation and stream flow characteristics occurring over and within a particular area for a given period of time. These data are used for many purposes, including the design, construction, and maintenance of a wide variety of structures in and along streams; the control and management of floods; the production of hydropower; the design and maintenance of navigation facilities; the control of pollution; the management of flood plains; the development of recreational facilities; the design of highway bridges and culverts; the establishing and administering of water rights and compacts; and the resolving of political, social, and legal water problems. As with any program, however, the restraint on funds and manpower, and the usefulness of the data obtained will determine to what extent the program will, or should, be pursued at any particular point in time. The overall program of observing, monitoring, and collection of hydrologic and meteorological data in the Kansas City District is quite extensive yet flexible to meet operational and economic needs. Brief descriptions of the various types of data collection now being utilized are presented in the following paragraphs.

Collection of Water Control Data.

Hydrologic data such as precipitation, stream flow, and lake information are collected in the Kansas City District by the following: observers, project offices, the National Weather Service (NWS), the Geological Survey (USGS), and the Bureau of Reclamation. Several different methods of

communication are used in the Kansas City District to collect these data. Telephone and fax communications are used to collect the data that come directly to the Water Control Section from observers and field personnel. Operational and hydrologic data for the Bureau of Reclamation's projects are transferred by email or fax by Reclamation's field office in McCook, Nebraska, to the Water Control Section. Stream flow and stage data are transmitted through a satellite downlink and a Domsat terminal from U.S. Geological Survey transmitters or directly from automated data collection platforms. National Weather Service precipitation data and river forecasts are transferred automatically between agency servers. Weather data, radar observations, and a large amount of subsidiary information is also available through the Internet. Data received by the District is entered onto the Section's Unix server database by both automated and manual methods, depending on the data source. Software developed by Section personnel provide a means to view, screen, and process the data for graphical and reporting purposes. The data is then uploaded to the Penstock database located at the Division Reservoir Control Center in Omaha. Selected data reports are transmitted back to the National Weather Service server at the same time. Once entered into the Division database, the data and reports are available to users Division-wide for forecasting, data listings, reports, bulletins, charts, program processing, and modeling.

Automatic Remote Sensors.

Data Collection Platforms (DCP's) are the primary means by which the District obtains remote sensing data on stream stages and lake elevations. DCP's automatically transfer data through a GOES satellite to the NESS and Omaha downlinks. NESS relays data directly to the District through a Domsat terminal. The Kansas City District currently has 161 DCPs in use. A breakdown of the total number of DCPs, by states, shows 51 units in Missouri, 93 in Kansas, 13 in Nebraska, and 4 in Iowa.

Cooperative Hydrologic Programs.

Restraints on funds and manpower do not allow the Corps to administer an independent data collection program that satisfies all of its needs. Therefore, assistance is sought from other cooperating agencies. A nationwide program of data collection at selected stream gauging stations has been administered for a number of years by the Geological Survey (USGS). A similar network of reporting stations has been operated by the National Weather Service (NWS) for their river forecasting services. Arrangements have also been made with the USGS and the NWS through which they supplement their network of reporting stations, or increase the frequency of reports, to better satisfy Corps of Engineers' needs. These programs, designated the "Cooperative Hydrologic Reporting Network," are administered by the USGS and the NWS and are supported by funds transferred to the two agencies from the Corps. Arrangements for the services provided are made with local representatives of the two agencies and submitted annually to the Chief of Engineers, through the Division Engineer, for review and approval. The District also funds a small number of its own local stream gauge observers to satisfy the needs of individual projects. A summary of funds expended for data collection purposes during the report period is included in the Personnel and Funding section at the end of this report.

Water Quality Investigations and Monitoring Activities.

The Water Quality Unit's (PM-PR-W) fiscal year 2000 activities were highlighted by the continuation of long-term studies of the Big Bull (Hillsdale Lake), Chariton (Rathbun Lake), and Little Platte (Smithville Lake) watersheds. The Big Bull Creek watershed studies with EPA 319 funding involve numerous federal, state, county, and local agencies, as well as citizen groups, in quantifying the levels of nutrients and herbicides throughout the watershed and implementing pollution reduction strategies. The latter include increased use of best management practices on agricultural lands and the use of constructed wetlands to improve the quality of point-source effluents. PM-PR-W continued to perform the lake-monitoring portion of the work, which included monthly insitu profiling of temperature, dissolved oxygen, conductivity, pH, and redox; secchi and photic zone measurements; sample collection and filtration; chlorophyll, turbidity, and suspended solids analyses; coordination with other laboratories; and data management.

In the fourth year of the multi-agency, cooperative study of the Chariton River watershed, PM-PR-W and Rathbun Lake project personnel teamed to perform monthly surveys of four lake stations and the outlet. Sampling of 14 tributaries was carried out by Iowa State University Limnology Laboratory personnel. PM-PR-W performed chlorophyll, turbidity, suspended solids, and immunoassay herbicide analyses while the Chemical and Materials Quality Assurance Laboratory (CMQAL) performed nitrogen and phosphorous group, sulfate, total dissolved solids, volatile solids, iron, manganese, total and dissolved organic carbon, and pesticide analyses. CMQAL also analyzed sediment and elutriate samples for the above parameters. PM-PR-W continued to provide data management for the long-term study. In addition, the unit presented a report on the first three years of the study at the annual public meeting. As in the Big Bull Creek watershed studies, the Natural Resources Conservation Service (NRCS) with major support from 319 funding assisted in obtaining the voluntary support of the agricultural community in reducing the amount of non-point source runoff.

For its part in the Little Platte River watershed studies, PM-PR-W again performed six monthly surveys of the three lake stations, the outlet, and the major tributary in 2000. Physical, chemical, and biological analyses noted above were performed by PM-PR-W and CMQAL. Reports were provided to various members of the study team and to the general public.

In addition to Rathbun, the following lake projects supported the District water quality monitoring effort in 2000: Long Branch, Clinton, Perry, Milford, Tuttle Creek, Wilson, Kanopolis, Pomona, and Harlan County. Approximately 130 samples per month were collected by project personnel at lake, outlet, and inflow stations and analyzed by PM-PR-W and CMQAL for herbicides and nutrients, respectively. Also PM-PR-W provided equipment, training, and technical support to the cooperating projects.

Other activities to support the sampling and analytical capabilities of PM-PR-W were procurement of supplies and equipment, maintenance and calibration of field and laboratory equipment, and maintenance of mobile laboratory and marine equipment. The unit also carried out a quality assurance/quality control (QA/QC) program with the cooperating laboratories.

Sediment Observations.

During the Fiscal Year 2000 reporting period, cross sections were surveyed at stream channel degradation ranges downstream of Harlan County, Hillsdale, and Milford Dams as part of a regular cycle of monitoring. Harlan County Dam is located in Nebraska, and Milford and Hillsdale Dams are located in eastern Kansas. The cross sections were plotted and compared to the last survey. At Harlan County, the surveys showed degradation in the range of 0.5 feet to 2.0 feet in the 80-mile reach from the dam to Superior since 1989. Except for local scour, there has been no significant degradation downstream of Hillsdale Dam since the last surveys in 1978 and 1996. At Milford, there has been very little change in the outlet channel itself, but in the natural river reach downstream towards Junction City there has been an average of 8 feet of degradation since 1967.

Complete hydrographic surveys were completed at Harlan County Lake in Nebraska and Tuttle Creek Lake in Kansas and Iowa. The sediment cross sections were plotted, and new area-capacity tables have been developed. After further review, the new tables will likely be implemented in early 2001.

Through an interagency cooperative agreement with the USGS, the Kansas City District collects point, depth integrated, and bed sample sediment samples at three Missouri River stations and two inflow stations to Harry S. Truman Reservoir. The Missouri River data at St. Joseph, Kansas City, and Hermann include point velocities. Laboratory analyses are performed at the USGS laboratory at Rolla, Missouri, and the results are stored in their database. The suspended sediment load data for the Schell City and Clinton are published by the USGS.

As noted in the previous section, bed material core samples were obtained at Rathbun Lake to be used in the Rathbun lake Water Quality Model. The Kansas City District hydrographic survey crews conducted sediment and hydrographic surveys on 37 lakes in Kansas at the request of the Kansas Water Office. 22 of the lakes were within the District boundaries, and 15 were in the Tulsa District. The data was used to develop digital terrain models of each lake and to revise area-capacity tables. The hydrographic crews are now beginning a survey of 218 cross sections on Lake of the Ozarks in Missouri for the Federal Emergency Management Agency. The surveys will be used in a Flood Insurance Study.

RESEARCH AND STUDIES.

Water Control Section staff are included on a District team for the Upper Mississippi River Basin Flow Frequency Study, a cooperative study with four other Districts, other Federal agencies, and public and academic interests. During this reporting period, Kansas City District completed work on the observed, unregulated and current level daily flow analysis for the lower Missouri River tributaries. The modeling work on the Kansas and Osage rivers was completed by contract, and the analysis of the main stem Missouri River and other minor tributaries was completed by Water Control personnel. Omaha District incorporated the District analysis into their main stem models to combine the upper Missouri River data with the lower basin data and produce data sets for use by Saint Louis District in their Mississippi River analysis. Other District personnel are working on the frequency analysis of the main stem unregulated and current level regulated flows, the mapping effort along the main stem of the Missouri River, and updating the Missouri River UNET model. Work on a 1920's development version of the UNET model was completed by contract. The Bureau of Reclamation completed work on the historic and current level depletions analysis of the Missouri River basin by interagency agreement.

Water Control Section staff are also part of a District team providing information and analysis for Republican River Basin studies being conducted by the Bureau of Reclamation. The Corps is a cooperating agency for these studies, and the work will contribute to a separate District operational study of Harlan County Lake. The work has also led to the revision of an operating agreement with Reclamation for Harlan County Dam. This agreement was described in an earlier section describing operations at Corps and Reclamation projects.

TRAINING AND METHODS.

Training of Water Control Section personnel progresses as time and scheduling permit. Technical abilities are enhanced as individuals continue to pursue courses on their own initiative. During the period of this report, employees of the Water Control Section participated in the training courses listed in Table 4. In addition, all personnel attended in-house training on ISO Business Procedures.

Table 4: Staff Training

Employee	Course or Training
Debbie Noble	Basic HMS
Steve Spaulding	Introduction to WMS
	Hydrologic Engineering Applications for GIS

PERSONNEL AND FUNDING.

Personnel.

Authorized positions of the Water Control Section at the close of this reporting period (July 31, 2000) consisted of one Supervisory Hydraulic Engineer, four Hydraulic Engineers, one Hydrologist, and three Hydrologic Technicians. The third Hydrologic Technician reports for duty in February 2001. The Hydrologist position in being advertised. The selectee will likely report for duty in April 2001. A listing of personnel currently employed in the Water Control Section by name and title is shown in Table 5.

Table 5: Water Control Section Staffing

Employee	Phone
Richard Oldham (1)	(816) 983-3545
Alan Bruns (3)	"
Paul Hansen (2)	"
Jim Knapp (2)	"
Debbie Noble (3)	"
Edward Parker (2)	"
Steve Spaulding (2)	"
Hydrologist (vacant)	"
Hydro Tech (vacant)	"

Job Title
(1) Supervisory Hydraulic Engineer
(2) Hydraulic Engineer
(3) Hydrologic Technician

Funding.

Activities of the Water Control Section are funded from the following sources:

Planning.

Part of the funds appropriated for survey reports, flood plain information studies, and project planning studies are assigned to the Water Control Section for special studies if water control management plans are included in connection with the planning and design of projects in the Kansas City District.

Operations and Maintenance.

Operation of the existing lakes and reservoirs in the Kansas City District requires stream flow forecasting, water control management planning, stream gauging, and other related activities for each authorized function at Corps of Engineers' projects, and for the flood control function at Bureau of Reclamation projects. Operation and maintenance funds are used for these purposes.

Technical Services and Flood Emergency.

Technical services provided to non-Federal interests, flood emergency operations, post flood reports, and the annual flood report are tasks assigned to the Water Control Section. These activities vary from year to year. Special accounts are provided for these services.

Data Collection Programs.

The Cooperative Reporting Network (FC-33 Program) with the National Weather Service involves financial support for reporting data from 64 precipitation stations. Funds in the amount of $19,278 for Fiscal Year 2001 were transferred from the Kansas City District to the National Weather Service.

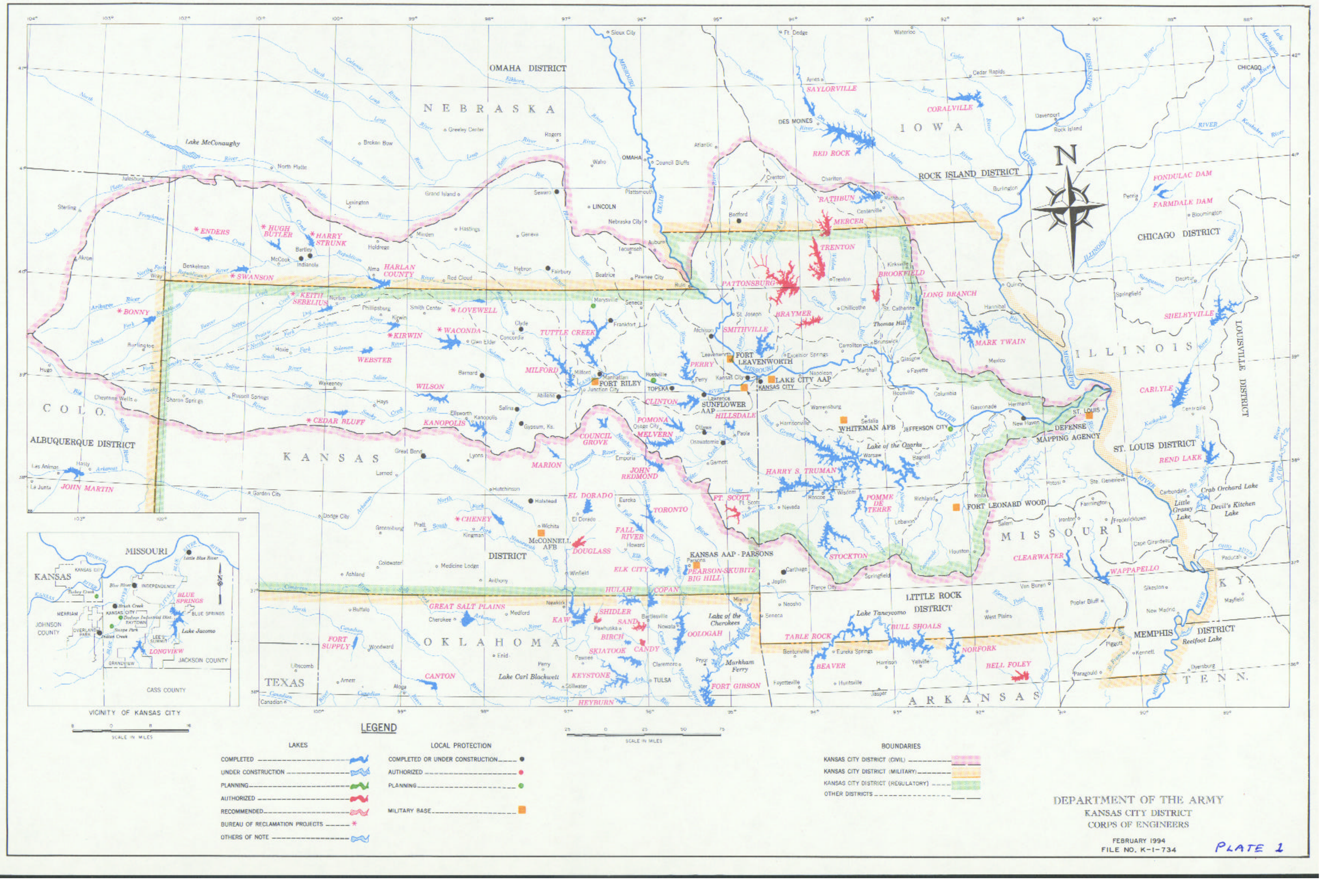
The Cooperative Stream Gauging Program with the four U.S. Geological Survey Districts (Kansas, Nebraska, Iowa, and Missouri) includes 146 stations. Kansas City District funding for this program during Fiscal Year 2001 is $1,154,334.

Stage data were obtained by the Kansas City District during the period of this report from 21 independent stations, either under contract or where supplies are issued for the purpose of data collection. The cost of this program totaled $5,000 in both Fiscal Years 2000 and 2001.

Fiscal year expenses for data collected in FY 2000 and FY 2001are shown in Table 6.

Table 6: Data Collection Expenditures

Program	FY-2000	FY-2001
FC-33 (NWS)	$36,538	$19,278
U.S.G.S	$1,141,494	$1,154,334
Independent Stations	$5,000	$5,000
TOTAL	$1,183,032	$1,178,612


OMAHA DISTRICT
NEBRASKA
IOWA
ROCK ISLAND DISTRICT
CHICAGO DISTRICT
ILLINOIS
LOUISVILLE DISTRICT
ST. LOUIS DISTRICT
MISSOURI
KANSAS
COLO.
ALBUQUERQUE DISTRICT
OKLAHOMA
TEXAS
KANSAS CITY DISTRICT
LITTLE ROCK DISTRICT
MEMPHIS DISTRICT
KY.
TENN.
ARKANSAS
KANSAS AAP - PARSONS
FORT RILEY
FORT LEAVENWORTH
LAKE CITY AAP
KANSAS CITY
SUNFLOWER AAP
WHITEMAN AFB
DEFENSE MAPPING AGENCY
FORT LEONARD WOOD
McCONNELL AFB
OMAHA
Council Bluffs
LINCOLN
TOPEKA
Sioux City
Ft. Dodge
Waterloo
Cedar Rapids
Davenport
Rock Island
CHICAGO
DES MOINES
Creston
Burlington
Peoria
Springfield
Decatur
Quincy
Hannibal
St. Louis
Columbia
Jefferson City
Lake of the Ozarks
Lake McConaughy
SAYLORVILLE
CORALVILLE
RED ROCK
RATHBUN
MERCER
TRENTON
BROOKFIELD
LONG BRANCH
MARK TWAIN
FONDULAC DAM
FARMDALE DAM
SHELBYVILLE
CARLYLE
REND LAKE
Crab Orchard Lake
Little Grassy Lake
Devil's Kitchen Lake
Reelfoot Lake
PATTONSBURG
BRAYMER
SMITHVILLE
PERRY
CLINTON
HILLSDALE
POMONA
MELVERN
HARRY S. TRUMAN
POMME DE TERRE
STOCKTON
CLEARWATER
WAPPAPELLO
BULL SHOALS
NORFORK
TABLE ROCK
BEAVER
BELL FOLEY
Lake Taneycomo
Lake of the Cherokees
Markham Ferry
FORT GIBSON
OOLOGAH
SKIATOOK
KEYSTONE
Lake Carl Blackwell
KAW
SHIDLER
SAND
BIRCH
CANDY
HULAH
COPAN
PEARSON-SKUBITZ
BIG HILL
ELK CITY
FALL RIVER
DOUGLASS
TORONTO
EL DORADO
FT. SCOTT
CHENEY
GREAT SALT PLAINS
FORT SUPPLY
CANTON
HEYBURN
TUTTLE CREEK
MILFORD
WILSON
CEDAR BLUFF
KANOPOLIS
COUNCIL GROVE
MARION
JOHN REDMOND
WEBSTER
KIRWIN
WACONDA
LOVEWELL
HARLAN COUNTY
SWANSON
KEITH SEBELIUS
BONNY
HUGH BUTLER
HARRY STRUNK
ENDERS
JOHN MARTIN
Lake Jacomo
BLUE SPRINGS
LONGVIEW
JACKSON COUNTY
CASS COUNTY
JOHNSON COUNTY
INDEPENDENCE
KANSAS CITY
RAYTOWN
MERRIAM
OVERLAND PARK
LEE'S SUMMIT
GRANDVIEW
VICINITY OF KANSAS CITY
SCALE IN MILES
LEGEND
LAKES
COMPLETED
UNDER CONSTRUCTION
PLANNING
AUTHORIZED
RECOMMENDED
BUREAU OF RECLAMATION PROJECTS
OTHERS OF NOTE
LOCAL PROTECTION
COMPLETED OR UNDER CONSTRUCTION
AUTHORIZED
PLANNING
MILITARY BASE
BOUNDARIES
KANSAS CITY DISTRICT (CIVIL)
KANSAS CITY DISTRICT (MILITARY)
KANSAS CITY DISTRICT (REGULATORY)
OTHER DISTRICTS
N
DEPARTMENT OF THE ARMY
KANSAS CITY DISTRICT
CORPS OF ENGINEERS
FEBRUARY 1994
FILE NO. K-1-734
PLATE 1

SUBJECT	MELVERN LAKE	POMONA LAKE	HILLSDALE LAKE	STOCKTON LAKE	POMME DE TERRE LAKE	HARRY S. TRUMAN RESERVOIR	REMARKS
GENERAL							(1) With pool at multipurpose level.
Location of Dam	Near Melvern, KS	Near Pomona, KS	Near Paola, KS	Near Stockton, MO	Near Hermitage MO	Near Warsaw, MO	(2) Damming height is from valley floor to top of the flood pool.
Stream / River	Marais des Cygnes River	110 Mile Creek	Big Bull Creek	Sac River	Pomme de Terre River	Osage River	(3) Based on latest available storage data. The dates of the current area - capacity tables are indicated below with the effective dates in parentheses:
Miles above Mouth	175.4	8.3	18.2	51.4	45.6	175.1	Melvern, February 1986 (effective 1 March 1986)
Contributing Drainage Area, sq miles	349	322	144	1,160	611	8,914 (4)	Pomona, March 1990 (effective 1 April 1990)
Approximate Length of Full Reservoir, miles	22	12	15	24	28	122	Hillsdale, 1969 (initial)
Shoreline, miles (1)	101	52	51	298	113	958	Stockton, February 1988 (effective 1 March 1988)
Maximum Discharge of Record near Damsite	68,500 cfs (11 July 1951)	38,600 cfs (11 July 1951)	45,200 cfs (11 July 1951)	120,000 cfs (19 May 1943)	70,000 cfs (8 August 1927)	259,000 cfs (17 May 1943)	Pomme de Terre, February 1985 (effect 1 Mar 85)
Date of Closure	2 October 1970	19 July 1962	15 June 1980	23 September 1968	28 June 1960	21 July 1977	Harry S. Truman, April 1993 (effective 1 Mar 94)
Date Storage Began	1 August 1972	18 October 1963	19 September 1982	12 December 1969	29 October 1961	7 February 1979	(4) Total drainage area above Truman Reservoir is 11,500 square miles. The indicated total is the local drainage area below the upstream dams.
Multipurpose Level Reached	4 April 1975	5 June 1965	23 February 1985	18 December 1971	15 June 1963	29 November1979	
Operating Agency	Corps of Engineers	Corps of Engineers	Corps of Engineers	Corps of Engineers	Corps of Engineers	Corps of Engineers	
DAM AND EMBANKMENT							
Top of Dam Elevation, feet msl	1,078	1,031	952.2	911	906	756	
Length of Dam, feet (net)	9,650	7,750	8,700 plus 3,300 dike	5,100 plus 5,600 dike	4,630 plus 2,790 dike	5,000 plus 7,500 dike	
Damming Height, feet (2)	105	83	79	132	124	105	
Type of Fill	Earth	Earth	Earth	Rock Shell	Earth	Earth	
Fill Quantity, cubic yards	9,100,000	5,200,000	6,964,000	7,100,000	5,800,000	8,500,000	
SPILLWAY							
Location	Left Abutment	Right Abutment	Right Abutment	Left Abutment	Right Abutment	Center of Dam	
Crest Elevation, feet msl	1,057	1,006	935	861.5	874	692.3	
Width, Feet	200	200	50	160	170	160	
Number, Size, and Type of Gates	None	None	None	4 - 40'x30.5' Tainter	None	4 - 40'x47.3' Tainter	
Discharge Capacity, Top of Surcharge Pool	36,000 cfs	50,300 cfs	4,750 cfs	182,500 cfs	73,000 cfs	284,000 cfs	
RESERVOIR (3)							**TOTALS**
Surcharge Pool Elevation and Area	1,073 ft msl 22,673 ac	1,025.4 ft msl 14,584 ac	948 ft msl 10,983 ac	906.2 ft msl 48,053 ac	900.2 ft msl 25,456 ac	751.1 ft msl 295,870 ac	417,619 ac
Flood Control Pool Elevation and Area	1,057 ft msl 13,935 ac	1,003 ft msl 8,522 ac	931 ft msl 7,413 ac	892 ft msl 38,281 ac	874 ft msl 15,999 ac	739.6 ft msl 209,048 ac	293,198 ac
Multipurpose Pool Elevation and Area	1,036 ft msl 6,912 ac	974 ft ft msl 3,865 ac	917 ft msl 4,575 ac	867 ft msl 24,632 ac	839 ft msl 7,790 ac	706 ft msl 55,406 ac	103,180 ac
Surcharge Storage	(1,073 - 1,057) 289,410 af	(1,025.4 - 1,003) 255,327 af	(948 - 931) 155,799 af	(906.2 - 892) 608,708 af	(900.2 - 874) 535,724 af	(751.1 - 739.6) 2,910,768 af	4,755,736 af
Flood Control Storage	(1,057 - 1,036) 208,207 af	(1,003 - 974) 176,123 af	(931 - 917) 83,570 af	(892 - 867) 776,066 af	(874 - 839) 406,821 af	(739.6 - 706) 4,006,415 af	5,657,202 af
Multipurpose Storage	(1,036 - 960) 152,051 af	(974 - 912) 64,208 af	(917 - 852.5) 76,270 af	(867 - 760.4) 874,887 af	(839 - 750) 237,356 af	(706 - 630) 1,180,617 af	2,585,389 af
Gross Storage	(1,057 - 960) 360,258 af	(1,003 - 912) 240,331 af	(931 - 852.5) 159,840 af	(892 - 760.4) 1,650,953 af	(874 - 750.1) 644,177 af	(739.6 - 630) 5,187,032 af	8,242,591 af
Sediment Reserve Storage	26,000 af	28,000 af	11,000 af	25,000 af	13,000 af	244,000 af	347,000 af
Estimated Annual Sediment Inflow	260 af 100 years	280 af 100 years	110 af 100 years	250 af 100 years	260 af 50 years	2,440 af 100 years	
OUTLET WORKS							
Location	Right Abutment	Right Abutment	Left Abutment		Right Abutment		ac = acres
River Outlet Type	Gated Horseshoe Conduit	Gated Horseshoe Conduit	Gated Oblong Conduit	None	Gated Tunnel	None	af = acre-feet
Number and Size of Conduit	1 - 11.5'	1 - 13.5'	1 - 15.92'x11.67'		1 - 14'		ft = feet
Length of Conduit, feet	754	720.5	685		560		msl = elevation above mean sea level
Entrance Invert Elevation	962 ft msl	925 ft msl	868 ft msl		750 ft msl		cfs = cubic feet per second
Discharge Cap, Top of Surcharge Pool	6,700 cfs	9,200 cfs	8,200 cfs		12,750 cfs		kw = kilowatts
Discharge Cap, Top of Flood Control Pool	6,235 cfs	8,170 cfs	7,400 cfs		11,500 cfs		hp = horsepower
Discharge Cap, Top of Multipurpose Pool	5,520 cfs	6,400 cfs	6,150 cfs		9,650 cfs		
Service Gates, Number and Size	2 - 6'x12'	2 - 6.5'x14'	2 - 5.33'x15.92'		2 - 6.5'x14'		
Emergency Gates, Number and Size	2 - 6'x12'	2 - 6.5'x14'	1 - 5.33'x15.92'		1 - 6.5'x14'		
Low Flow Gates, Number and Size	2 - 2'x2'	2 - 2'x2'	2 - 2'x2'	2 - 24" dia	1 - 24" Butterfly		
Provision for Power	None	None	None	3 - 20'x40'		12 - 17'x26.5'	
POWER FACILITIES							
Generator Turbine Units, Number				1		6	
Generator Name Plate Capacity, kw				45,200		160,000	
Turbine Rating, hp				75,600 (56 ft head)		254,400	
Turbine Type				Kaplan (Vertical Shaft)		Kaplan (Inclined Shaft)	
Maximum (Full Pool) Head and Discharge				112 ft (6,300 cfs)		79.2 ft (31,800 cfs)	
Avg (Power & MP Pool) Head and Discharge				85 ft (7,900 cfs)		42.5 ft (65,000 cfs)	
Minimum Head and Discharge				62 ft (11,000 cfs)		41 ft (68,000 cfs)	
Reversible Pump Turbines				None		6	
Total Dynamic Head, feet						50	
Discharge. 5 Units at Max Head, cfs						27,500	
Maximum Power Required, hp						197,000	
Maximum Drawdown, feet msl				845		704	

SUMMARY OF ENGINEERING DATA
OSAGE RIVER BASIN PROJECTS

US Army Corps of Engineers
Kansas City District
December 2000

PLATE 2A

SUBJECT	SMITHVILLE LAKE	LONGVIEW LAKE	BLUE SPRINGS LAKE	RATHBUN LAKE	LONG BRANCH LAKE	TOTALS
GENERAL						
Location of Dam	Near Smithville, MO	Kansas City, MO	Kansas City, MO	Near Rathbun, IA	Near Macon, MO	
Stream / River	Little Platte River	Little Blue River	East Fork Little Blue River	Chariton River	East Fork Little Chariton River	
Miles above Mouth	13.6	42.9	28.8	142.3	78	
Contributing Drainage Area, sq miles	213	50.3	32.8	549	109	
Approximate Length of Full Reservoir, miles	18	3.5	2.5	14	9	
Shoreline, miles (1)	175	24	12	155	24.2	
Maximum Discharge of Record Near Damsite	76,600 cfs (20 July 1965)	18,700 cfs (13 August 1982)	11,000 cfs (13 August 1982)	21,800 cfs (31 March 1960)	30,000 cfs (21 April 1973)	
Date of Closure	13 July 1976	16 June 1983	12 August 1986	29 September 1967	3 September 1976	
Date Storage Began	19 October 1979	16 September 1985	27 September 1988	21 November 1969	2 August 1978	
Multipurpose Level Reached	11 June 1982	22 September 1986	18 March 1990	10 October 1970	19 May 1981	
Operating Agency	Corps of Engineers	Corps of Engineers	Corps of Engineers	Corps of Engineers	Corps of Engineers	
DAM AND EMBANKMENT						
Top of Dam Elevation, feet msl	895	926.6	840	946	826	
Length of Dam, feet (net)	4,000	1,900	2,500	10,600	3,550	
Damming Height, feet (2)	80.2	110	70	82	71	
Type of Fill	Rolled Earth	Earth	Earth and Rock	Rolled Earth	Rolled Earth	
Fill Quantity, cubic yards	3,200,000	2,500,000	1,200,000	4,700,000	1,855,000	
SPILLWAY						
Location	Right Abutment	Left Abutment	Left Abutment	Right Abutment	Right Abutment	
Crest Elevation, feet msl	880.2	911.3	823.6	926	809	
Width, feet	50	200	300	500	50	
Number, Size, and Type of Gates	None	None	None	None	None	
Discharge Capacity, Top of Surcharge Pool	4,800 cfs	22,970 cfs	37,800 cfs	45,600 cfs	9,860 cfs (4)	
RESERVOIR (3)						
Surcharge Pool Elevation and Area	891.1 ft msl 14,611 ac	922.9 ft msl 3,207 ac	837.7 ft msl 1,200 ac	940.0 ft msl 29,475 ac	821.2 ft msl 6,608 ac (4)	55,101 ac
Flood Control Pool Elevation and Area	876.2 ft msl 9,990 ac	909.0 ft msl 1,964 ac	820.3 ft msl 982 ac	926.0 ft msl 20,974 ac	801.0 ft msl 3,663 ac	37,573 ac
Multipurpose Pool Elevation and Area	864.2 ft msl 7,115 ac	891.0 ft msl 927 ac	802.0 ft msl 722 ac	904.0 ft msl 10,989 ac	791.0 ft msl 2,429 ac	22,182 ac
Recreation Pool Elevation and Area		870.0 ft msl 432 ac				432 ac
Surcharge Storage	(891.1 - 876.2) 182,198 af	(922.9 - 909.0) 35,370 af	(837.7 - 820.3) 19,039 af	(940.0 - 926.0) 349,499 af	(821.2 - 801.0) 101,888 af (4)	687,994 af
Flood Control Storage	(876.2 - 864.2) 101,777 af	(909.0 - 891.0) 24,810 af	(820.3 - 802.0) 15,715 af	(926.0 - 904.0) 345,791 af	(801.0 - 791.0) 30,327 af	518,420 af
Multipurpose Storage	(864.2 - 799.0) 141,666 af	(891.0 - 870.0) 13,579 af	(802.0 - 760.0) 10,842 af	(904.0 - 855.0) 199,830 af	(791.0 - 751.1) 34,189 af	400,106 af
Recreation Storage		(870.0 - 810.4) 8,555 af				8,555 af
Gross Storage	(876.2 - 799.0) 243,443 af	(909.0 - 810.4) 46,944 af	(820.3 - 760.0) 26,557 af	(926.0 - 855.0) 545,621 af	(801.0 - 751.0) 64,516 af	927,081 af
Sediment Reserve Storage	52,300 af	2,000 af	300 af	24,000 af	4,000 af	82,600 af
Estimated Annual Sediment Inflow	523 af 100 years	20 af 100 years	3 af 100 years	240 af 100 years	40 af 100 years	
OUTLET WORKS						
Location	Right Abutment	Left Abutment	Right Abutment	Right Abutment	Right Abutment	
River Outlet Type	Rectangular Conduit	Concrete Arch	Arch Conduit	Horseshoe Conduit	Concrete Arch	
Number and Size of Conduit	1 - 8'x9'	1 - 5.5'x5'	1 - 3.5'x4.75'	1 - 11'	1 - 6'x5.5'	
Length of Conduit, feet	696	916	485	539	450	
Entrance Invert Elevation	805 ft msl	816 ft msl	768.5 ft msl	855 ft msl	760 ft msl	
Drop Inlet Crest Elevation		891	802.0 ft msl			
Low Flow Gate Intake Elevation		875 - 861	791.5			
Discharge Cap, Top Flood Control Pool	3,150 cfs	1,200 cfs	570 cfs	5,160 cfs (5)	910 cfs	
Discharge Cap, Top of Multipurpose Pool	2,940 cfs	0 (except low flow outlets)	0 (except low flow outlets)	4,220 cfs (5)	495 cfs	
Service Gates, Number and Size	2 - 4.25'x9.25' Slide			2 - 6'x12' Slide	2 - 24" Slide	
Emergency Gates, Number and Size	2 - 4.25'x9.25' Slide	1 - 6'x7'	1-4.5'x5'	2 - 6'x12' Slide	1 - 6'x6'	
Low Flow Gates, Number, Size, Type		2 - 24" Knife Valves	1-2' Knife Valve			
Low Flow Gates, Number and Size	1 - 2'x2'	2 - 24" Knife Valves	1-2' Knife Valve	2 - 2' x2' Slide	1 - 18" Slide	
Provision for Water Supply	1 - 5.75' Pipe					
Provision for Power	None	None	None	None	None	

(1) With pool at multipurpose level.
(2) Damming height is from valley floor to top of flood control pool.
(3) Based on latest available storage data. The dates of the current area capacity tables are indicated below with the effective dates in parenthesis:
Smithville Lake, February 1990 (effective 1 March 1990)
Longview Lake, May 1970 (initial)
Blue Springs Lake, September 1974 (initial)
Rathbun Lake, January 1982 (effective 1 January 1982)
Long Branch Lake, January 1989 (effective 1 July 1989)
(4) Spillway flood routing at Long Branch Lake revised for Emergency Action Plan, dated 1981.
(5) The Rathbun outlet works cannot discharge more than 1,800 cfs without special approval from the Water Control office. Flows above 1,800 cfs result in overtopping of the outlet works stilling basin walls.

ac = acres
af = acre-feet
ft = feet
msl = elevation above mean sea level
cfs = cubic feet per second

SUMMARY OF ENGINEERING DATA
LOWER MISSOURI RIVER BASIN PROJECTS

US Army Corps of Engineers
Kansas City District
December 2000

PLATE 2B

SUBJECT	MILFORD LAKE	TUTTLE CREEK LAKE	PERRY LAKE	CLINTON LAKE	TOTALS
GENERAL					
Location of Dam	Near Junction City, KS	Near Manhatten, KS	Near Perry, KS	Near Lawrence, KS	
Stream / River	Republican River	Big Blue River	Delaware River	Wakanusa River	
Miles above Mouth	7.7	10	5.3	22.2	
Contributing Drainage Area, sq miles	17,388 (4)	9,628	1,117	367	
Approximate Length of Full Reservoir, miles	30	50	20	17	
Shoreline, miles (1)	163	112	160	82	
Maximum Discharge of Record near Damsite	171,000 cfs (3 June 1935)	98,000 cfs (June 1951)	94,600 cfs (June 1951)	24,200 cfs (July 1951)	
Date of Closure	24 August 1964	20 July 1959	2 August 1966	23 August 1975	
Date Storage Began	16 January 1967	7 March 1962	15 January 1969	30 November 1977	
Multipurpose Level Reached	14 July 1967	30 April 1963	3 June 1970	3 April 1980	
Operating Agency	Corps of Engineers	Corps of Engineers	Corps of Engineers	Corps of Engineers	
DAM AND EMBANKMENT					
Top of Dam Elevation, feet msl	1,213	1,159	946	928	
Length of Dam, feet (net)	6,300	7,487	7,750	9,250	
Damming Height, feet (2)	110.2	134	95	114	
Type of Fill	Earth	Earth, Rock	Earth	Earth	
Fill Quantity, cubic yards	15,000,000	21,000,000	8,000,000	10,423,000	
SPILLWAY					
Location	Right Abutment	Left Abutment	Left Abutment	Left Abutment	
Crest Elevation, feet msl	1,176.2	1,116	922	907.4	
Width, feet	1,250	1,059	300	500	
Number, Size, and Type of Gates	None	18 - 40'x20' Tainter	None	None	
Discharge Capacity, Top of Surcharge Pool	560,000 cfs	579,000 cfs	65,000 cfs	44,200 cfs	
RESERVOIR (3)					
Surcharge Pool Elevation and Area	1,208.2 ft msl 59,886 ac	1,151.4 fr msl 69,900 ac	941.2 ft msl 42,656 ac	921.4 ft msl 18,336 ac	190,778 ac
Flood Control Pool Elevation and Area	1,176.2 ft msl 32,979 ac	1,136.0 ft msl 53,679 ac	920.6 ft msl 25,363 ac	903.4 ft msl 12,890 ac	124,911 ac
Multipurpose Pool Elevation and Area	1,144.4 ft msl 15,709 ac	1,075.0 ft msl 12,367 ac	891.5 ft msl 11,146 ac	875.5 ft msl 7,120 ac	46,342 ac
Surcharge Storage	(1,208.2 - 1,176.2) 1,442,049 af	(1,151.4 - 1,136.0) 957,179 af	(941.2 - 920.6) 692,375 af	(921.4 - 903.4) 285,809 af	3,377,412 af
Flood Control Storage	(1,176.2 - 1,144.4) 756,669 af	(1,136.0 - 1,075.0) 1,895,828 af	(920.6 - 891.5) 515,795 af	(903.4 - 875.5) 268,783 af	3,437,075 af
Multipurpose Storage	(1,144.4 - 1,080.0) 388,816 af	(1,075.0 - 1,010.0) 298,883 af	(891.5 - 835.0) 209,513 af	(875.5 - 820.0) 125,334 af	1,022,546 af
Gross Storage	(1,176.2 - 1,080.0) 1,145,485 af	(1,136.0 - 1,010.0) 2,194,711 af	(920.6 - 835.0) 725,308 af	(903.4 - 820.0) 394,117 af	4,459,621 af
Sediment Reserve Storage	160,000 af	233,000 af	140,000 af	28,500 af	561,500 af
Estimated Annual Sediment Inflow	1,600 af 100 years	4,700 af 50 years	1,400 af 100 years	285 af 100 years	
OUTLET WORKS					
Location	Right Abutment	Right Abutment	Near Center of Dam	Left Abutment	
River Outlet Type	Gated Conduit	Gated Conduit	Gated Conduit	Gated Conduit	
Number and Size of Conduit	1 - 21'	2 - 20'	1 - 23.5'	1 - 12.5'x13' Arch	
Length of Conduit, feet	615.5	860	592	710	
Entrance Invert Elevation	1,080 ft msl	1,003 ft msl	833 ft msl	828 ft msl	
Gated Sluice, Number and Size	None	None	None	None	
Discharge Cap, Top of Flood Control Pool	23,100 cfs	45,900 cfs	27,500 cfs	7,570 cfs	
Discharge Cap, Top of Multipurpose Pool	18,600 cfs	31,300 cfs	21,200 cfs	5,900 cfs	
Service Gates, Number and Size	2 - 10.5'x21'	4 - 10'x20'	2 - 11.75'x23.5'	2 - 6.33'x12.67'	
Emergency Gates, Number and Size	2 - 10.5'x21'	1 - 10'x20'	2 - 11.75'x23.5'	1 - 6.33'x12.67'	
Low Flow Gates, Number and Size	2 - 2'x2'	2 - 24" Butterfly Valve	2 - 2'x2'	1 - 24" Knife Gate Value	
Water Supply Gate, Number and Size	None	None	None	1 - 54"x54" Slide Gate	
Provision for Irrigation	None	None	None	None	
Provision for Power	None	None	None	None	
Provision for Water Supply	None	None	None	36" Steel Pipe	

REMARKS

(1) With pool at multipurpose level.
(2) Damming height is from valley floor to top of flood control pool.
(3) Based on latest available storage data. The dates of the current area - capacity tables are indicated below with the effective dates in parentheses:
Milford Lake, March 1982 (effective 10 March 1982)
Tuttle Creek Lake, December 1996 (effective 1 February 1999)
Perry Lake, May 1990 (effective 1 June 1990)
Clinton Lake, December 1991 (effective 1 March 1994)
(4) Total drainage area above Milford is 38,621 square miles. The indicated total is the local drainage area below Harlan County Dam.

ac = acres
af = acre-feet
ft = feet
msl = elevation above mean sea level
cfs = cubic feet per second

SUMMARY OF ENGINEERING DATA
LOWER KANSAS RIVER BASIN PROJECTS

US. Army Corps of Engineers
Kansas City District
December 2000

PLATE 2C

SUBJECT	BONNY RESERVOIR	SWANSON LAKE	ENDERS RESERVOIR	HUGH BUTLER LAKE	HARRY STRUNK LAKE	KEITH SEBELIUS LAKE (Norton Dam)	HARLAN COUNTY LAKE	LOVEWELL RESERVOIR	REMARKS
GENERAL									
Location of Dam	Near Hale, CO	Near Trenten, NE	Near Enders, NE	Near McCook, NE	Near Cambridge, NE	Near Norton, KS	Nr Republican City, NE	Near Lovewell, KS	(1) With pool at MP level.
Stream / River	S. Fk Republican River	Republican River	Frenchman Creek	Red Willow Creek	Medicine Creek	Prairie Dog Creek	Republican River	White Rock Creek	(2) Damming height is
Miles above Mouth	60.4	359	81.7	18.7	11.9	74.9	232.3	19.3	from valley floor to top of
Contributing Drain Area, sq miles	1,435	3,941	786	310	642	688	13,536	358	flood control pool.
Approx Length of Full Resv, miles	5.5	9.0	6.0	7.5	8.5	9.5	17	11	(3) Based on latest storage
Shoreline, miles (1)	15.0	30	26	35	29	32	54	44	data. Date of current area
Max. Disch. of Record near Damsite	103,000 (31 May 1935)	200,000 (31 May 1935)	Insufficient Data	30,000 (22 June 1947)	120,000 (June 1947)	37,500 (28 May 1953)	260,000 (1 June 1935)	23,300 (10 July 1950)	capacity tables given below
Date of Closure	6 July 1950	4 May 1953	23 October 1950	5 September 1961	8 August 1949	28 January 1964	22 July 1951	29 May 1957	with effective date in ( ).
Date Storage Began	6 July 1950	4 May 1953	23 October 1950	5 September 1961	8 August 1949	5 October 1964	14 November 1952	2 October 1957	Bonny, Mar 51 (initial)
Multipurpose Level Reached	19 March 1954	15 May 1957	29 January 1952	21 May 1967	2 April 1951	21 June 1967	14 June 1957	20 May 1958	Swanson, Feb 84 (Feb 84)
Operating Agency	Bureau of Reclamation	Bureau of Reclamation	Bureau of Reclamation	Bureau of Reclamation	Bureau of Reclamation	Bureau of Reclamation	Corps of Engineers	Bureau of Reclamation	Enders, May 97 (1 Jan 99)
DAM AND EMBANKMENT									Butler, May 97 (1 Jan 99)
Top of Dam Elevation, feet msl	3,742.0	2,793.0	3,137.5	2,634.0	2,415.0	2,347.0	1,982.0	1,616.0	Strunk, May 81 (Oct 82)
Length of Dam, feet (Less Spillway)	9,141.5	8,600	2,242	3,159	5,665	6,344	11,830	8,392	Sebelius, Jun 65 (initial)
Damming Height, feet (2)	93.0	80.0	93.0	About 85	86	85.5	98.5	70.3	Harlan, Dec 89 (1 Jan 90)
Type of Fill	Earth	Earth	Earth	Earth	Earth	Earth	Earth	Earth	Lovewell, Jun 95 (1 Jan 97)
Fill Quantity, cubic yards	8,853,000	8,130,000	1,950,000	3,122,000	2,730,000	3,740,000	13,400,000	3,000,000	(4) Bartley Div Dam, Rep
SPILLWAY									R. below Red Willow Ck,
Location	Left Abutment	Left Abutment	Right Abutment	Right Abutment	Left Abutment	Right Abutment	Center of Dam	Right Abutment	conc ogee weir w/2-10x16
Crest Elevation, feet msl	3,710.0	2,743.0	3,097.0	2,604.9	2,386.2 (see also below)	2,296.0	1,943.5	1,575.3	gates to rivr, 2-10'x3' gates
Width, feet	121.5	142	361	31.5 (circ morning glory)	229	106	856	53	to canal, max cap 130 cfs.
Number, Size, and Type of Gates	None (see notes below)	3 - 42' x 30' Radial	6 - 50' x 30' Radial	None	None	3 - 30'x36.35' Radial	18 - 40'x30' Radial	2 - 25'x20' Radial	Franklin pumps on Rep R.
Disch. Cap. Top of Surcharge Pool	73,300 cfs (with sluice)	126,000 cfs	202,000 cfs (with notch)	4,910 cfs	99,000 cfs (with notch)	96,000 cfs	480,000 cfs	35,000 cfs	blw Harlan Cty, cap 40 cfs.
RESERVOIR (3)									**TOTALS**
Surcharge Pool Elev (ft msl), Area	3,736.2 8,579 ac	2,785.0 10,035 ac	3,129.5 ft msl 2,557 ac	2,628.0 ft msl 4,079 ac	2,408.9 ft msl 5,784 ac	2,341.0 ft msl 6,713 ac	1,975.5 ft msl 24,135 ac	1,610.3 ft msl 7,635 ac	69,517 ac
Flood Cntrl Pool Elev (ft msl), Area	3,710.0 5,036 ac	2,773.0 7,940 ac	3,127.0 ft msl 2,405 ac	2,604.9 ft msl 2,681 ac	2,386.2 ft msl 3,483 ac	2,331.4 ft msl 5,316 ac	1,973.5 ft msl 22,820 ac	1,595.3 ft msl 5,024 ac	54,705 ac
MP, or Top Cons Pool Elev, Area	3,672.0 2,042 ac	2,752.0 4,922 ac	3,112.3 ft msl 1,707 ac	2,581.8 ft msl 1,621 ac	2,366.1 ft msl 1,840 ac	2,304.3 ft msl 2,181 ac	1,946.0 ft msl 13,262 ac	1,582.6 ft msl 2,987 ac	30,562 ac
Inactive Pool Elev (ft msl), Area	3,638.0 331 ac	2,720.0 1,411 ac	3,082.4 ft msl 627 ac	2,558.0 ft msl 715 ac	2,343.0 ft msl 701 ac	2,280.4 ft msl 587 ac	1,927 ft msl 7,365 ac	1,571.7 ft msl 1,495 ac	13,232 ac
Dead Stor Pool Elev (ft msl), Area	3,635.5 242 ac	2,710.0 488 ac	3,080.0 ft msl 577 ac	2,552.0 ft msl 536 ac	2,335.0 ft msl 481 ac	2,275.0 ft msl 391 ac	1,885.0 ft msl 0 ac	1,562.07 ft msl 494 ac	3,209 ac
Surcharge Storage, af	(3,736.2-3,710) 178,230	(2,785 - 2,773) 107,610	(3,129.5 - 3,127) 6,203	(2,628.0-2,604.9) 76,829	(2,408.9-2,386.2)105660	(2,341 - 2,331.4) 58,285	(1,975.5-1,973.5) 46,947	(1,610.3-1,595.3) 94,140	673,904 af
Flood Control Storage, af	(3,710 - 3,672) 128,820	(2,773 - 2,752) 134,077	(3,127 - 3,112.3) 30,048	(2,604.9-2,581.8) 48,846	(2,386.2-2,366.1) 52,715	(2,331.4-2,304.3) 98,803	(1,973.5-1,946) 496,718	(1595.3 - 1582.6) 50,465	1,040,492 af
MP, or Active Conserv Storage, af	(3,672 - 3,638) 39,206	(2,752 - 2,720) 99,784	(3,112.3-3,082.4) 33,962	(2,581.8 - 2,558) 27,303	(2,366.1 - 2,343) 26,846	(2,304.3-2,280.4) 30,651	(1,946-1,932.4) 149,415	(1,582.6-1,571.7) 24,022	431,189 af
Inactive Storage, af	(3,638 - 3,635.5) 716	(2,720 - 2,710) 10,312	(3,082.4 - 3,080) 1,432	(2,558 - 2,552) 3,736	(2,343 - 2,335) 4,699	(2,880.4 - 2,275) 2,566	(1932.4 - 1,885) 165,675	(1,571.7-1,562.07) 9,985	199,121 af
Dead Storage, af	(3,635.5 - 3,617) 1,418	(2,710 - 2,693) 2,118	(3,080 - 3,042) 7,516	(2,552 - 2,511) 5,185	(2,335 - 2,318.5) 4,160	(2,275 - 2,247) 2,718	(Sluice crest at 1,885) 0	(1,562.07-1,535) 1,659	24,774 af
Gross Storage, af	(3,710 - 3,617) 170,160	(2,773 - 2,693) 246,291	(3,127 - 3,042) 72,958	(2,604.9 - 2,511) 85,070	(2,386.2-2,318.5) 88,420	(2,331.4-2,247) 134,738	(1,973.5-1,885) 811,808	(1,595.3 - 1,535) 86,131	1,695,576 af
Sediment Reserve Storage							200,000 af		
Estimated Annual Sediment Inflow	160 af 50 years	1,020 af 50 years	400 af 50 year	200 af 50 years	150 af 50 years	120 af 50 years	2,000 af 100 years	Actual 6024 af (1957-95)	
OUTLET WORKS									Courtland Div Dam, Rep R
Location	Left Abutment	Left Abutment	Right Abutment	Right Abutment	Right Abutment	Left Abutment	Center of Dam	Right Abutment	at Guide Rock, conc ogee
River Outlet Type	Gated Conduit	Gated Conduit	Gated Conduit	Gated Conduit	Gated Conduit	Gated Conduit	Gated Sluices	Spillway gates used for	w/2-20'x12' gates to river
Number and Size of Conduit	1 – 56" Cond to 26" Pipe	2 - 6' x 7.5'	1 - 84" Cond to 84"Pipe	1 - 82"	1 – 84" Cond to 44" Pipe	1 – 48" Cond to 38" Pipe	9 - 5'x8' thru Spillway	river releases. Gated	5-10'x6'gates to Courtland
Length of Conduit, feet	831.5	86.74	516	553.5	553	495 to Gate, 145 to Basin		wasteway with 1-10'x9'	canal (cap 751 cfs), 1-10x6
Entrance Crest Elevation	3,635.5 ft msl	2,710.0 ft msl	3,080.0 ft msl	2,552.0 ft msl	2,335.0 ft msl	2,275.0 ft msl	1,885.0 ft msl	radial gate from outlet	gate to Superior (cap 139).
Disch Cap, Top of Flood Cntrl Pool	140 cfs (approx)	4,300 cfs	1,430 cfs	1,170 cfs	398 cfs (max elev 2,379)	312 cfs	20,700 cfs	canal to stilling basin.	Other private diversion
Disch Cap, Top of MP (Consv) Pool	103 cfs	3,500 cfs	1,300 cfs	990 cfs	361 cfs	257 cfs	17,370 cfs	Wasteway is not used.	weirs exist on some creeks
Service Gates, Number, Size, Type	1 - 24" Hollow Jet Valve	2 - 6' x 7.5' Slide Gates	2-60" Hollow Jet Valves	2 - 42" Slide Gates	1 - 39" Slide Gate	1 - 33" Slide Gate	9 - 5' x 8' Slide Gates	None	like Riverside blw Enders
Provision for Irrigation	1 - 32" Pipe to 24" Valve	1 - 56" Pipe to 4' Gate	None	None	None	None	1-5.5'; 1-2.83' Conduits	1 - 8'x10' Gated Outlet	but div capacity minimal.
Provision for Power	Note: Storage owned by	None	None	None	None	None	12'x12' Plug for 9' Cond	None	ac = acres
Provision for Municipal Supply	CO for F&W, Recreation	None	None	None	None	1 - 16" Pipe to 16" Gate	None	None	af = acre-feet
Other Outlet	1 - 40" Capped Conduit	None	None	None	None	None	Notes: USBR can distrib	Note: Inflow to lake also	ft = feet
							water equitably to canals	provided from gated	cfs = cubic feet per sec
	Notes: Spillway also has	Notes: Irrigation outlet	Notes: Spillway also has	Note: Concrete ogee weir	Notes: Spillway also has	Notes: Concrete ogee	to elev 1,927, their base	Courtland Canal outlet.	msl = elev abv mean sea lvl
	16.5'x21.5' sluice, with	in right abutment.	an uncontrolled notch w/	13 miles d/s w/ 1-6'x18'	an uncontrolled notch w/	weir 17.6 miles d/s, with	of active consv storage.		
	1 - 16.5' x 10.75'gate,	River outlets must be	crest elevation at 3112.3.	radial gate to river, and	crest elevation at 2366.1.	1 – 6'x18' radial gate to	1-18" outlet for low flow		
	crest elev 3,672.0. The	closed at pool elevations	Concrete ogee weir	2 - 5'x4' regulating gates	Concrete ogee weir at	river, 2 – 6'x5' gates to	reg. Franklin Canal cond		
	56" gated outlet conduit	above 2,773.0.	52 miles d/s w/ 2 14x9.5	to canal (max cap 90 cfs)	RM 301.6 on Rep. River.	Main Canal (cap 100 cfs)	to 2-36" gates, cap 520		
	feeds all three gated sub		gates plus 30" gated river	Bartley Diversion Dam	2-10'x14'gates to river	and 2 – 5'x4' gates to	cfs. Naponee Canal cond		
	outlets. Cap of irrig pipe		conduit, & 2 10'x6' gates	located below Rep. R.	and 4-10'x14' gates to	South Canal (capacity	to 1-24" valve, cap 40		
	outlet limited to 34.5 cfs.		to canal (cap 400 cfs).	confluence. See note (4)	canal (max cap 325 cfs).	36 cfs).	cfs. See also note (4)		

SUMMARY OF ENGINEERING DATA
REPUBLICAN RIVER BASIN PROJECTS

US. Army Corps of Engineers
Kansas City District
December 2000

PLATE 2D

SUBJECT	WACONDA LAKE	KIRWIN RESERVOIR	WEBSTER RESERVOIR	WILSON LAKE	KANOPOLIS LAKE	CEDAR BLUFF RESERVOIR	REMARKS
GENERAL							(1) With pool at multipurpose or full conservation level.
Location of Dam	Near Glen Elder, KS	Near Kirwin, KS	Near Stockton, KS	Near Wilson, KS	Near Ellsworth, KS	Near Ellis, KS	(2) Damming height is height from valley floor to top
Stream / River	Solomon River	North Fork Solomon River	South Fork Solomon River	Saline River	Smoky Hill River	Smoky Hill River	of flood control pool.
Miles above Mouth	172.4	67.8	92.4	153.9	183.7	333.4	(3) Based on latest available storage data. The dates of
Contributing Drain Area, sq miles	5,076 total (4)	1,367	1,150	1,917	7,860 total contributing (6)	5,365 total contributing	the current area - capacity tables are indicated below
Approx Length of Full Reservoir, miles (1)	24	9	7	24	12	9	along with the effective dates in parenthesis:
Shoreline, miles (1)	100	37	27	100	41	50	Waconda, June 1971 (initial)
Maximum Discharge of Record near Damsite	125,000 cfs (July 1951)	24,000 cfs (Sep 1919)	55,200 cfs (July 1951)	25,700 cfs (Jul-Aug 1928)	61,000 cfs (June 1938)	98,000 cfs (May 1938)	Kirwin, May 1996 (effective 1 January 1998)
Date of Closure	18 October 1967	7 March 1955	3 May 1956	3 September 1963	26 July 1946	13 November 1950	Webster, May 1996 (effective 1 January 1998)
Date Storage Began	24 July 1968	5 October 1955	3 May 1956	29 December 1964	17 February 1948	13 November 1950	Wilson, December 1984 (effective 1 January 1985)
Multipurpose Level Reached	16 May 1973	2 July 1957	18 June 1957	12 March 1973	19 July 1948	21 June 1951	Kanopolis, February 1983 (effective 1 March 1983)
Operating Agency	Bureau of Reclamation	Bureau of Reclamation	Bureau of Reclamation	Corps of Engineers	Corps of Engineers	Bureau of Reclamation	Cedar Bluff, 1951 (initial)
DAM AND EMBANKMENT							(4) DA below Kirwin, Webster Dams = 2,559 sq miles
Top of Dam Elevation, feet msl	1,500.0	1,779.0	1,944.0	1,592.0	1,537.0	2,198.0	(5) 7’ conduit from intake tower to gate chamber. 4’x5’
Length of Dam, feet (Less Spillway)	14,631	12,246	10,604	5,600	15,360	12,409.5	emergency gate to 60” pipe. Entrance to stilling well
Damming Height, feet (2)	107.9	95	84.7	114	102	102	controlled by 4’x5’ slide gate. From stilling well, 42”
Type of Fill	Earth	Earth	Earth	Earth	Earth	Earth	river outlet pipe controlled by 36” gate. River outlet
Fill Quantity, cubic yards	8,050,000	9,537,000	8,145,000	8,500,000	15,200,000	8,490,000	capacity at top of MP pool and flood control pool about
SPILLWAY							220 cfs. Length of combined pipes from intake to
Location	Right Abutment	Right Abutment	Left Abutment	Right Abutment	Right Abutment	Right Abutment	stilling well about 500’. About 200’ more to stilling
Crest Elevation, feet msl	1,467.4	1,757.3	1,884.6	1,582.0	1,507.0	2,166.0	basin. Canal releases from two openings at top of
Width, feet	644	400 (uncontrolled)	116	450 (uncontrolled)	500 (uncontrolled)	150.5 (uncontrolled length)	stilling well. Canal capacity is about 175 cfs, but
Number, Size, and Type of Gates	12 - 50’x21.76’ Radial	None, but see note below	3 – 33.33’x39.51’ Radial	None	None	Gated orifice, see note blw	combined capacity with river outlet about 395 cfs.
Discharge Capacity at Top of Surcharge Pool	278,000 cfs	96,000 cfs (sluices closed)	138,000 cfs	15,700 cfs	172,000 cfs	84,000 cfs (with orifice)	(6) DA below Cedar Bluff Dam = 2,330 sq miles
RESERVOIR (3)							**TOTALS**
Surcharge Pool Elevation (ft msl), Area	1,492.9 ft msl 38,178 ac	1,773.0 ft msl 14,660 ac	1,938.0 ft msl 11,270 ac	1,587.5 ft msl 33,882 ac	1,531.8 ft msl 23,408 ac	2,192.0 ft msl 16,510 ac	137,908 ac
Flood Control Pool Elevation (ft msl), Area	1,488.3 ft msl 33,682 ac	1,757.3 ft msl 10,639 ac	1,923.7 ft msl 8,478 ac	1,554.0 ft msl 20,027 ac	1,508.0 ft msl 13,958 ac	2,166.0 ft msl 10,790 ac	97,754 ac
Multipurpose, or Top Cons Pool Elev, Area	1,455.6 ft msl 12,602 ac	1,729.25 ft msl 5,071 ac	1,892.45 ft msl 3,767 ac	1,516.0 ft msl 9,045 ac	1,463.0 ft msl 3,406 ac	2,144.0 ft msl 6,869 ac	40,760 ac
Inactive Pool Elevation (ft msl), Area	1,428.0 ft msl 3,341 ac	1,697.0 ft msl 1,006 ac	1,860.0 ft msl 904 ac			2,107.8 ft msl 2,086 ac	
Dead Storage Pool Elevation (ft msl), Area	1,407.8 ft msl 350 ac	1,693.0 ft msl 765 ac	1,855.5 ft msl 440 ac			2,090.0 ft msl 909 ac	
Surcharge Storage, af	(1492.9-1488.3) 164,966 af	(1,773 - 1,757.3) 198,467 af	(1,938 - 1,923.7) 140,912 af	(1,587.5-1,554) 894,263 af	(1,531.8 - 1,508) 438,655 af	(2,192 - 2,166) 353,230 af	2,190,493 af
Flood Control Storage, af	(1488.3-1455.6) 722,315 af	(1757.3-1729.25) 215136 af	(1923.7-1892.45) 183353 af	(1,554 - 1,516) 530,204 af	(1,508 - 1,463) 369,278 af	(2,166 - 2,144) 191,860 af	2,212,146 af
MP, or Active Conservation Storage, af	(1,455.6 - 1,428) 204,789 af	(1,729.25-1,697) 89,639 af	(1,892.45-1,860) 71,926 af	(1,516 - 1,435) 242,528 af	(1,463 - 1,430) 49,474 af	(2,144 - 2,107.8) 149,770 af	808,126 af
Inactive Storage, af	(1,428 - 1,407.8) 35,435 af	(1,697 - 1,693) 3,546 af	(1,860 - 1,855.5) 2,975 af			(2,107.8 - 2,090) 27,059 af	69,015 af
Dead Storage, af	(1,407.8 - 1,386) 1,236 af	(1,693 - 1,662.3) 4,969 af	(1,855.5 - 1,839) 1,256 af			(2,090 - 2,064) 8,261 af	15,722 af
Gross Storage, af	(1,488.3-1,386) 963,775 af	(1757.3-1662.3) 313,290 af	(1,923.7 - 1,839) 259,510 af	(1,554 - 1,435) 772,732 af	(1,508 - 1,430) 418,752 af	(2,166 - 2,064) 376,950 af	3,105,009 af
Sediment Reserve Storage				40,000 af	51,500 af		
Estimated Annual Sediment Inflow	475 af 50 years	Actual 1,281 af (1955-96)	Actual 1,214 af (1956–96)	400 af 100 years	1,030 af 50 years	260 af 50 years	(7) In addition to the gated conduit, Kanopolis has an
OUTLET WORKS							uncontrolled port opening 3.5’x13.75’ in the 10’ pier
Location	Left Abutment	Center of Dam	Right Abutment	Right Abutment	Right Abutment	Left Abutment	separating the two service gate openings. Crest elevation
River Outlet Type	Gated Conduit	Gated Conduit	Gated Conduit	Gated Conduit	Gated Conduit (7)	Gated Conduit to River	of the port is 1,463 ft msl. The max discharges given
Number and Size of Conduit	1 - 12.5’	7’ Cond to 60” pipe (5)	4.5’ Conduit to 48” pipe	1 - 12’	1 - 14’	1 - 5.5’	for the outlet is the combined total of the port and gates.
Length of Conduit, feet	575	(5)	538	1,097	2,443	863.5	(8) River outlet crest elev is 2,090 ft msl. Crest elev of
Entrance Crest Elevation	1,407.8 ft msl	1,693 ft msl	1,855.5 ft msl	1,450 ft msl	1,415 ft msl	2,090 ft msl	sluices under spillway is 2,134.82 ft msl. River outlet
Gated Sluice, Number and Size	None	See note below	None	None	None	8 - 5’x5’, gated (8)	capacity at MP is 804 cfs, at top of flood pool is 909 cfs.
Discharge Cap, Top of Flood Control Pool	5,200 cfs	220 cfs (5)	480 cfs	6,500 cfs	6,400 cfs (7)	3,520 cfs (outlet, sluices) (8)	Cedar Bluff also has an irrig canal outlet on Y junction
Disch Cap, Top of MP (Conservation) Pool	4,000 cfs	220 cfs (5)	385 cfs	5,300 cfs	4,500 cfs (7)	7,949 cfs (outlet, sluices) (8)	from river outlet, 5.5’ pipe to control house, canal flow
Service Gates, Number, Size, Type	2 - 6.5’x8’ Slide Gates	1 - 4’x5’ to stilling well (5)	1 - 3.5’x3.5’ Slide Gate	2 - 6’x12’ Service Gates	2 - 6’x12’	1 - 4’x5’	controlled by 4’x5’ gate (not used since 1978, irrigation
Emergency Gates, Number and Size	1 - 9’x12’ Slide Gates	1 - 4’x5’ (5)	1 - 3.5’x3.5’ Slide Gate	2 - 6’x12’ Slide Gates	1 - 6’x12’	1 - 4’x5’	district disbanded in 1994). Also a hatchery supply
Low Flow Gates, Number and Size	None	None	None	2 - 2’x2’ Slide Gates	None	None	line from 18” valve on canal outlet, capacity 10 cfs.
Provision for Irrigation	None	2 - 5.5’x8’ openings (5)	None	None	None	1 - 4’x5’ (8)	Lake storage owned by KS, for benefit of recreation and
Provision for Power	None	None	None	None	See below	None	F&W. All releases coordinated with Kansas KDWP.
Provision for Municipal Supply	Supplied thru river releases.	None	None	None	See below	Thru river releases (9), but	(9) 2,000 af annual storage supply contract for Russell.
ABBREVIATIONS	City of Beloit has contracted for up to 2,000 af of annual storage releases. Mitchell County Rural Water District No. 2 has contracted for up to 1,009 af of annual storage releases.	Note: 15 - 5’ x 5’ gated sluices located in concrete ogee section below spillway crest. Crest elevation at sluice entrance = 1,720.0. Discharge capacity at top of conserv pool = 4,800 cfs,	Note: When reservoir elevation is below 1,860, the outlet gate openings must be reduced to prevent air entrainment in conduit.	Note: Low flow gates are mounted in the service gates Low flow gates are used for river releases up to 200 cfs.	Provision for future steel penstock in outlet tunnel for power. Post Rock Irrigation District has supply contract to pump water to a supply pipe from an outlet in the lake near the intake tower.	no releases in recent years. Spillway also has a gated orifice section at center with 1-14.5’x9.58’ radial gate, crest at 2,144. Spillway cap incl ogee & orifice. Sluices located in ogee section.	**SUMMARY OF ENGINEERING DATA SMOKY HILL RIVER BASIN PROJECTS**
ac = acres							U.S. Army Corps of Engineers
af = acre-feet							Kansas City District
ft = feet							December 2000
msl = elevation above mean sea level							
cfs = cubic feet per second							PLATE 2E

APPENDIX A
CORPS OF ENGINEERS PROJECTS

BLUE SPRINGS LAKE

CLINTON LAKE

HARLAN COUNTY LAKE

HARRY S. TRUMAN RESERVOIR

HILLSDALE LAKE

KANOPOLIS LAKE

LONG BRANCH LAKE

LONGVIEW LAKE

MELVERN LAKE

MILFORD LAKE

PERRY LAKE

POMME DE TERRE LAKE

POMONA LAKE

RATHBUN LAKE

SMITHVILLE LAKE

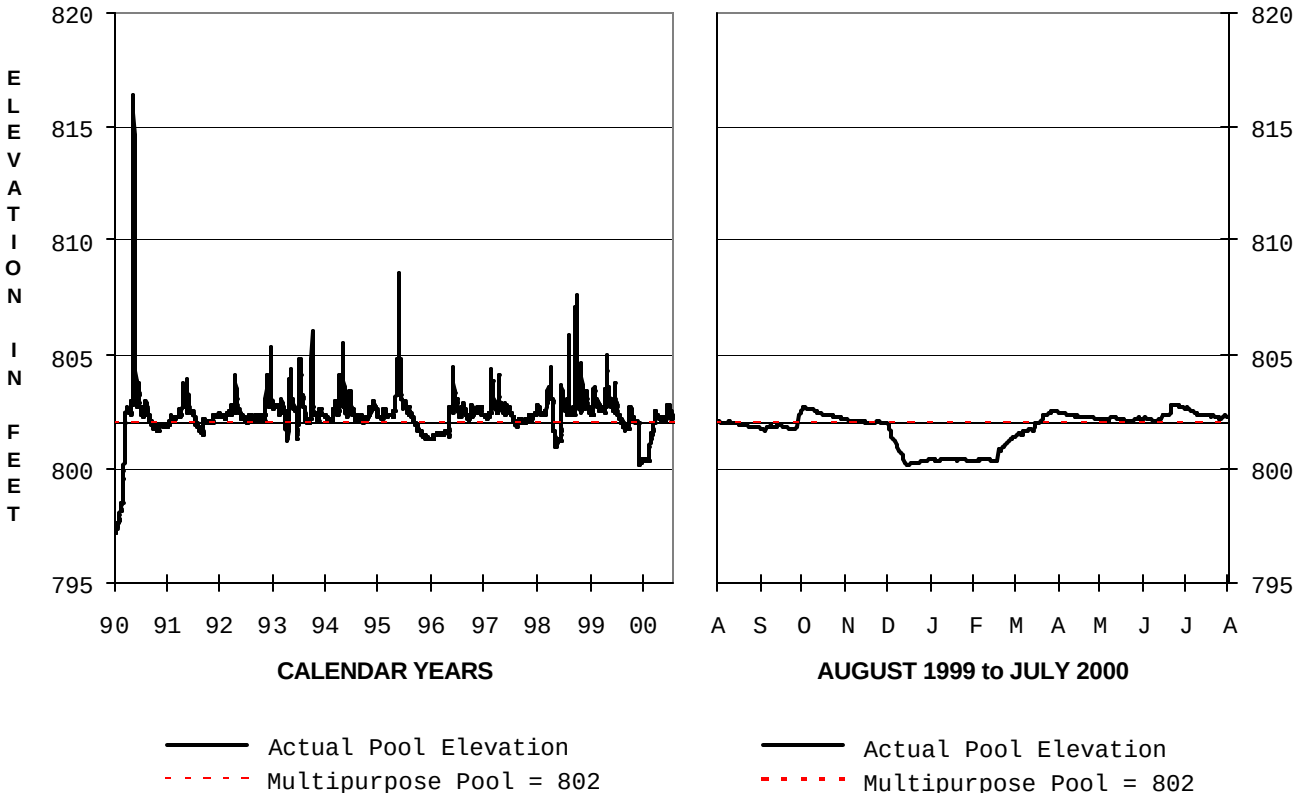
STOCKTON LAKE

TUTTLE CREEK LAKE

WILSON LAKE

BLUE SPRINGS LAKE
1999-2000 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

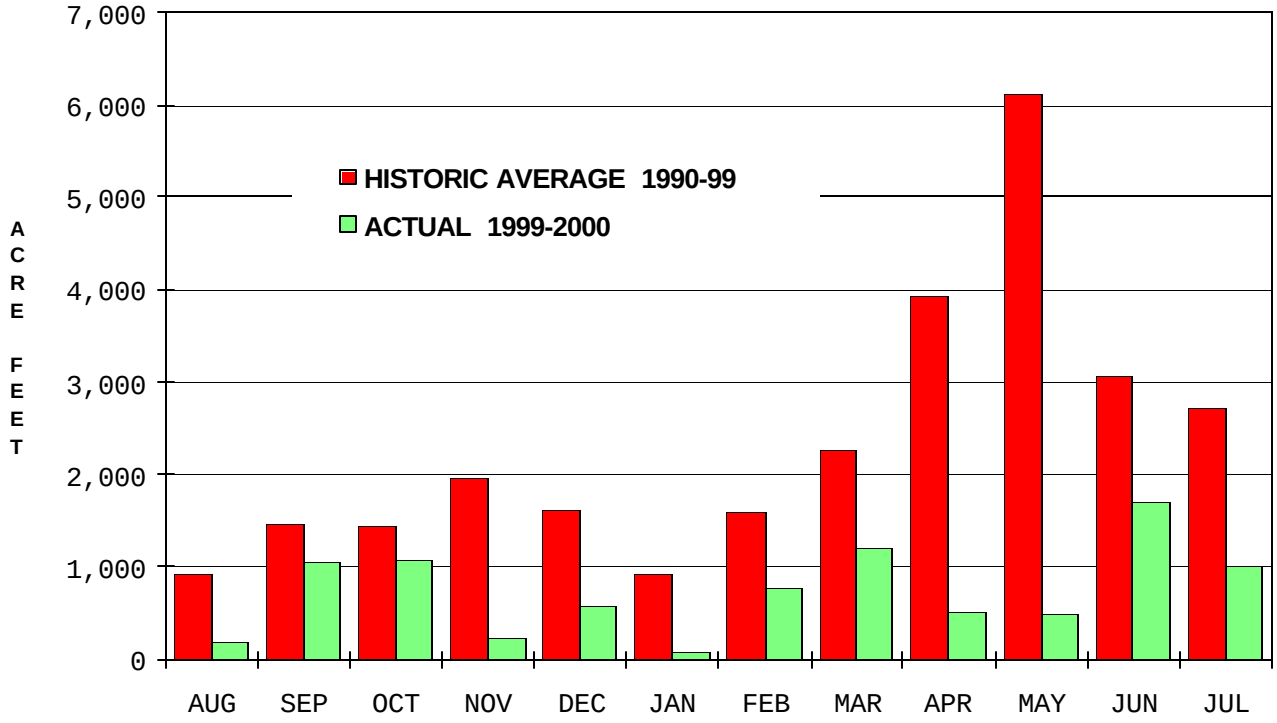


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
802.09 1 Aug 99	**802.25 31 Jul 00**	**802.82 21-22 Jun 00**	**800.10 15 Dec 99**	**816.37 16-17 May 90**	**800.10 14-15 Dec 99**

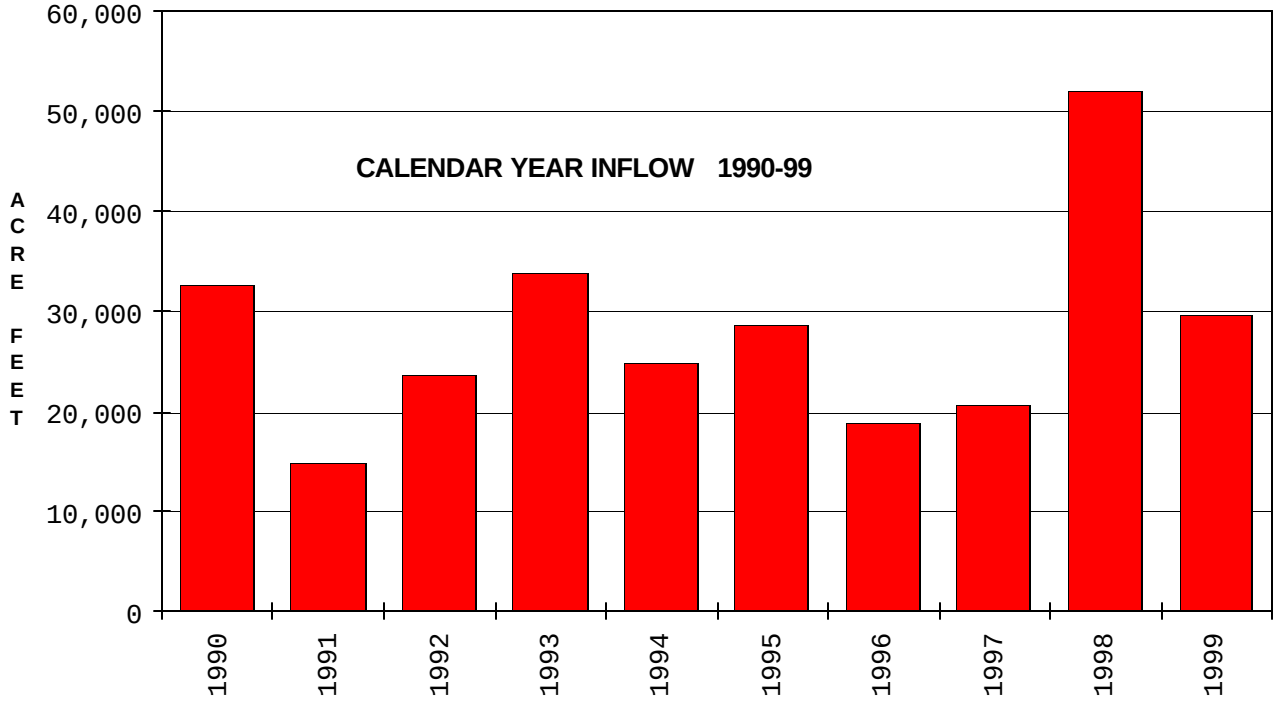
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
180 21 Jun 00	**8,887 55,382 AF previous period**	**60 2-14 Dec 99**	**0, most of mid-Sep through mid-March**

All releases are to the river. Reservoir lowered 2 feet in December for shore weed control.

BLUE SPRINGS LAKE MONTHLY INFLOW

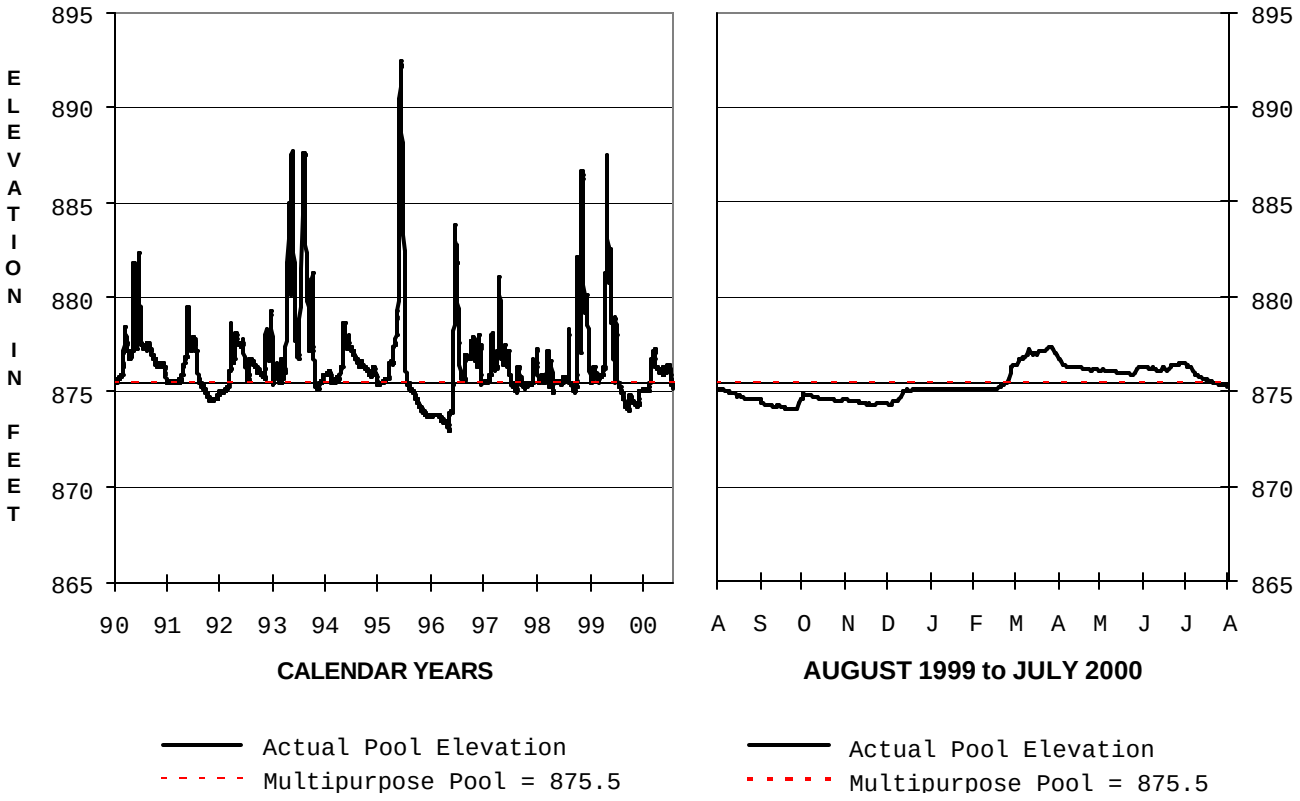


BLUE SPRINGS LAKE ANNUAL INFLOW



CLINTON LAKE
1999-2000 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

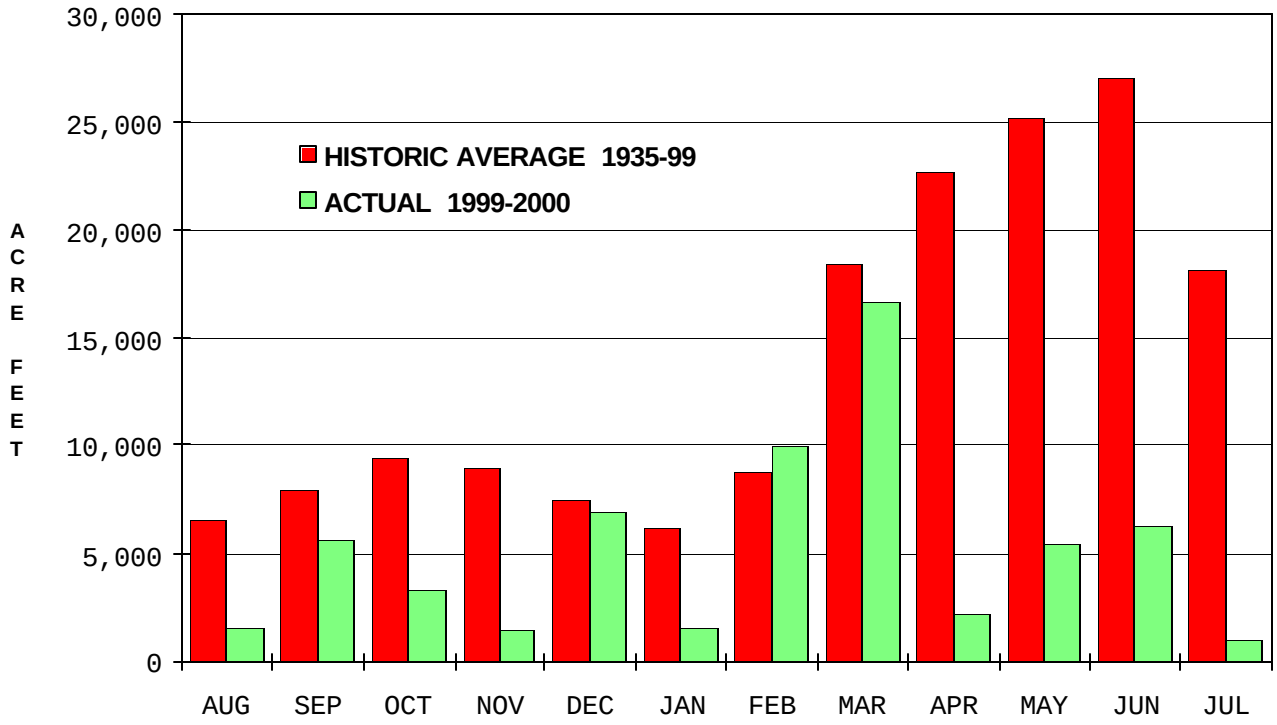


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
875.12 1 Aug 99	**875.23 31 Jul 00**	**877.31 25 Mar 00**	**874.03 26 Sep 99**	**892.48 29 May 95**	**871.60 18-19 Aug 89**

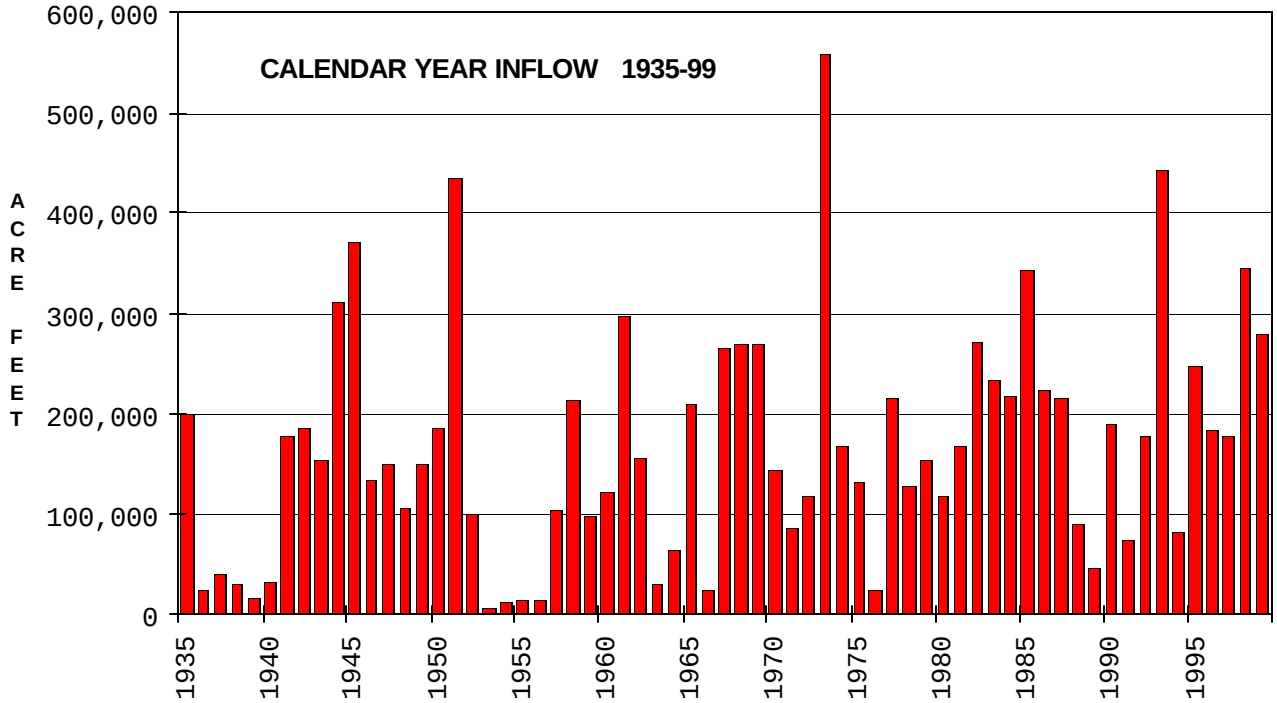
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
1,200 26 Feb 00	**62,024 497,395 AF previous period**	**500 24 Mar to 4 Apr 00**	**0 6-8 Mar 00**

Outflows to river only. Releases cut to 0 only for maintenance. Normal minimum release is 7-21 cfs.

CLINTON LAKE MONTHLY INFLOW

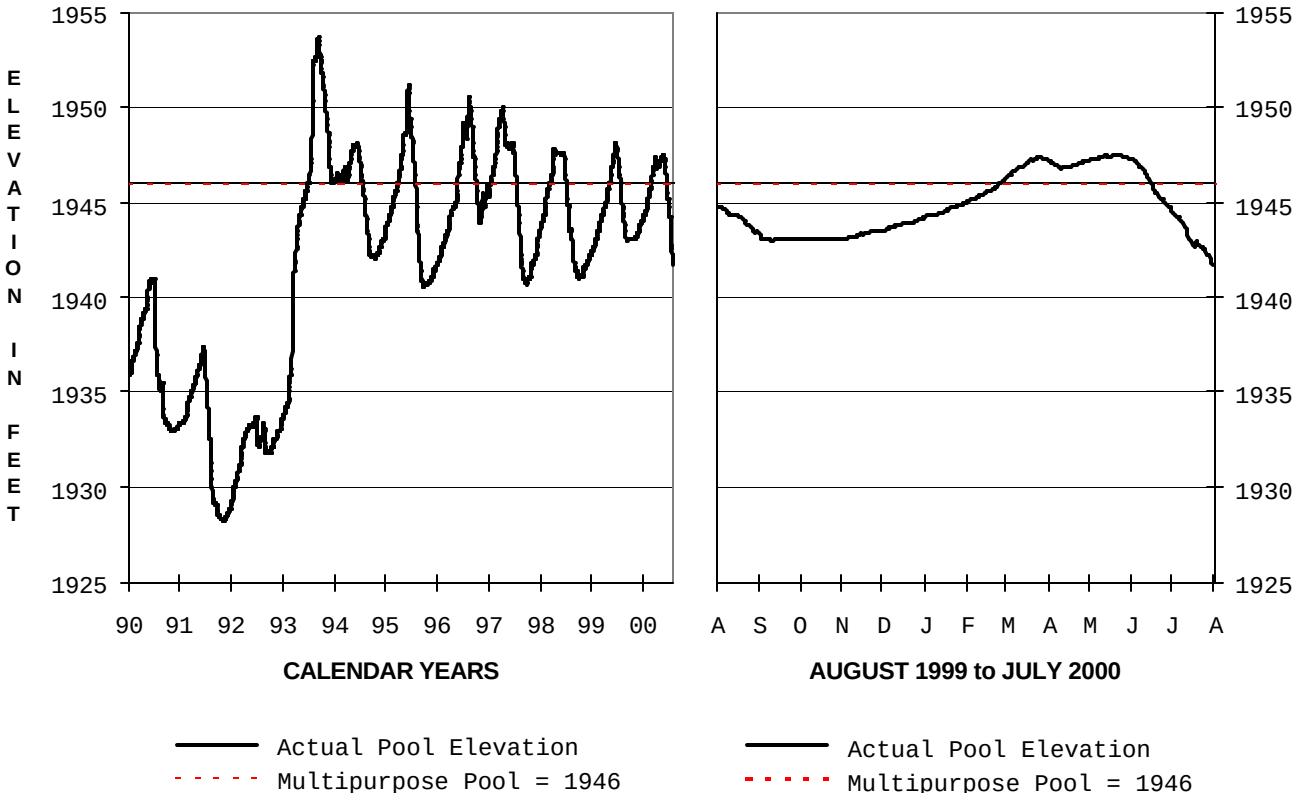


CLINTON LAKE ANNUAL INFLOW



HARLAN COUNTY LAKE
1999-2000 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

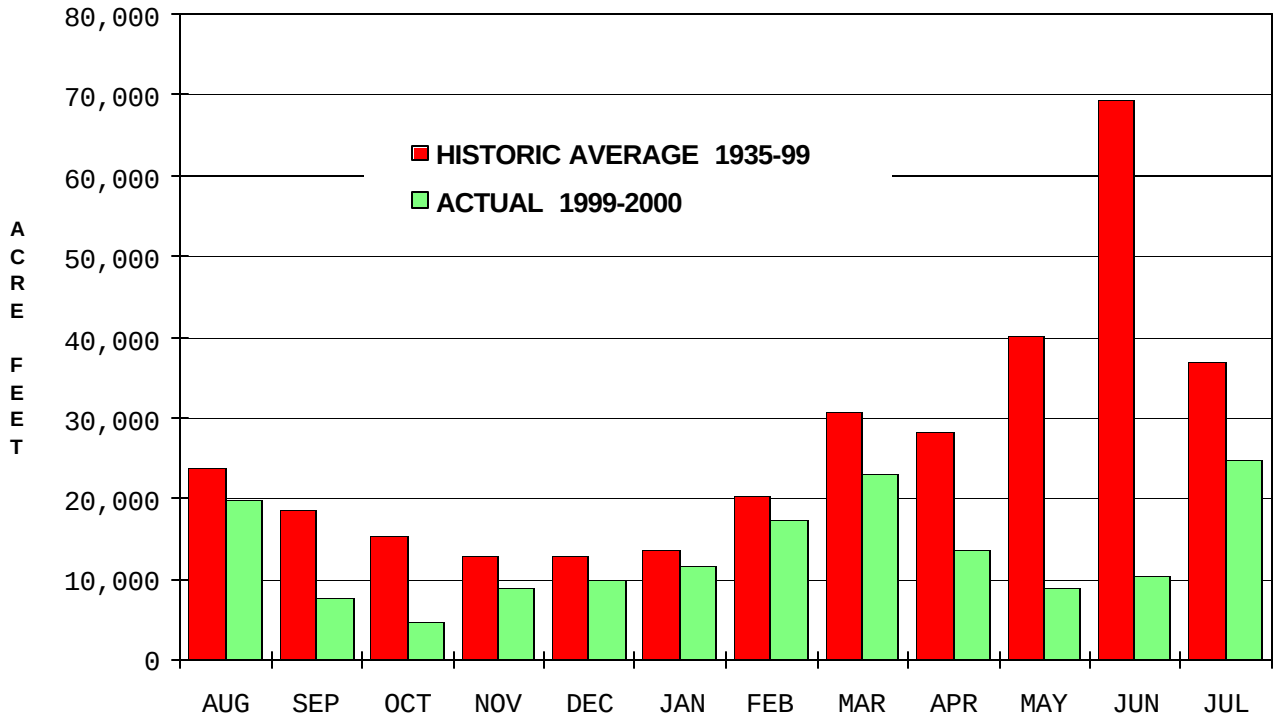


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1944.78 1 Aug 99	**1941.70 31 Jul 00**	**1947.53 18-22 May 00**	**1941.70 31 Jul 00**	**1955.66 5 Apr 60**	**1928.21 27-28 Oct 91**

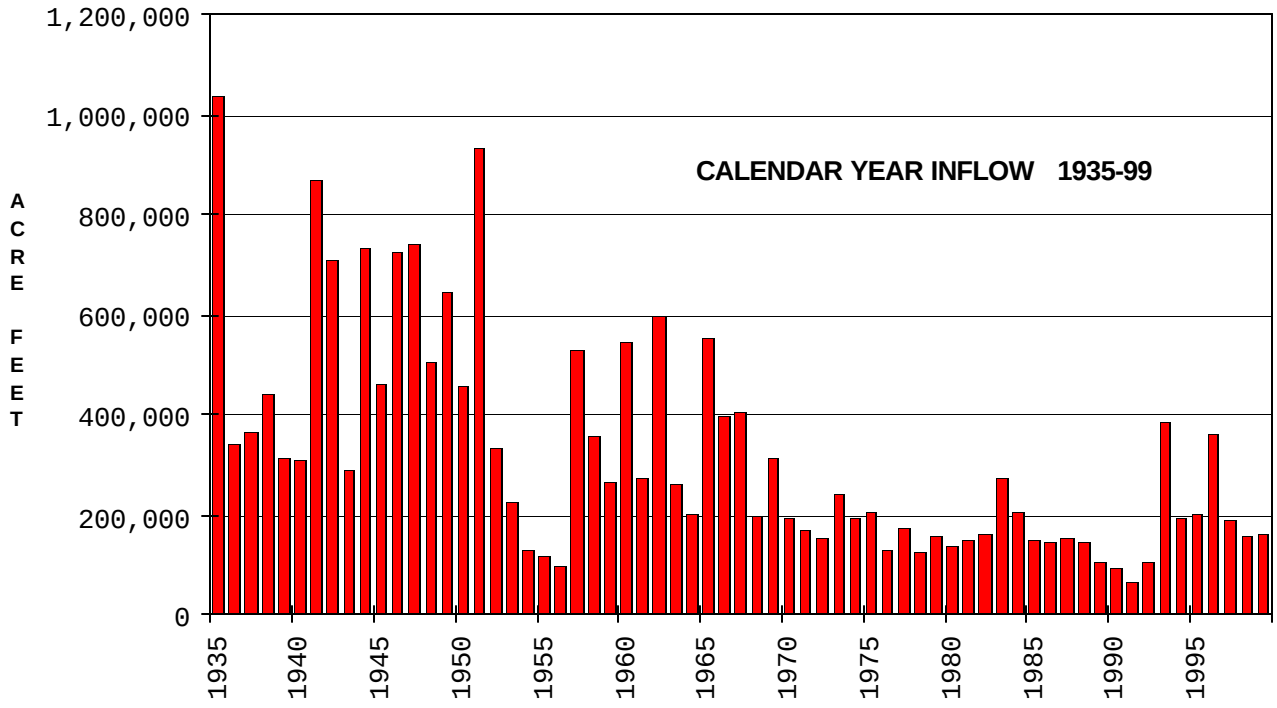
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
2,200 18 Jul 00	**159,976 152,238 AF previous period**	**725, several days 12 Jul to 4 Aug 00**	**0, normal min release varies from 0 to 10 cfs**

Max daily outflow to river occurred as part of normal releases for irrigation. Also have canal releases.

HARLAN COUNTY LAKE MONTHLY INFLOW

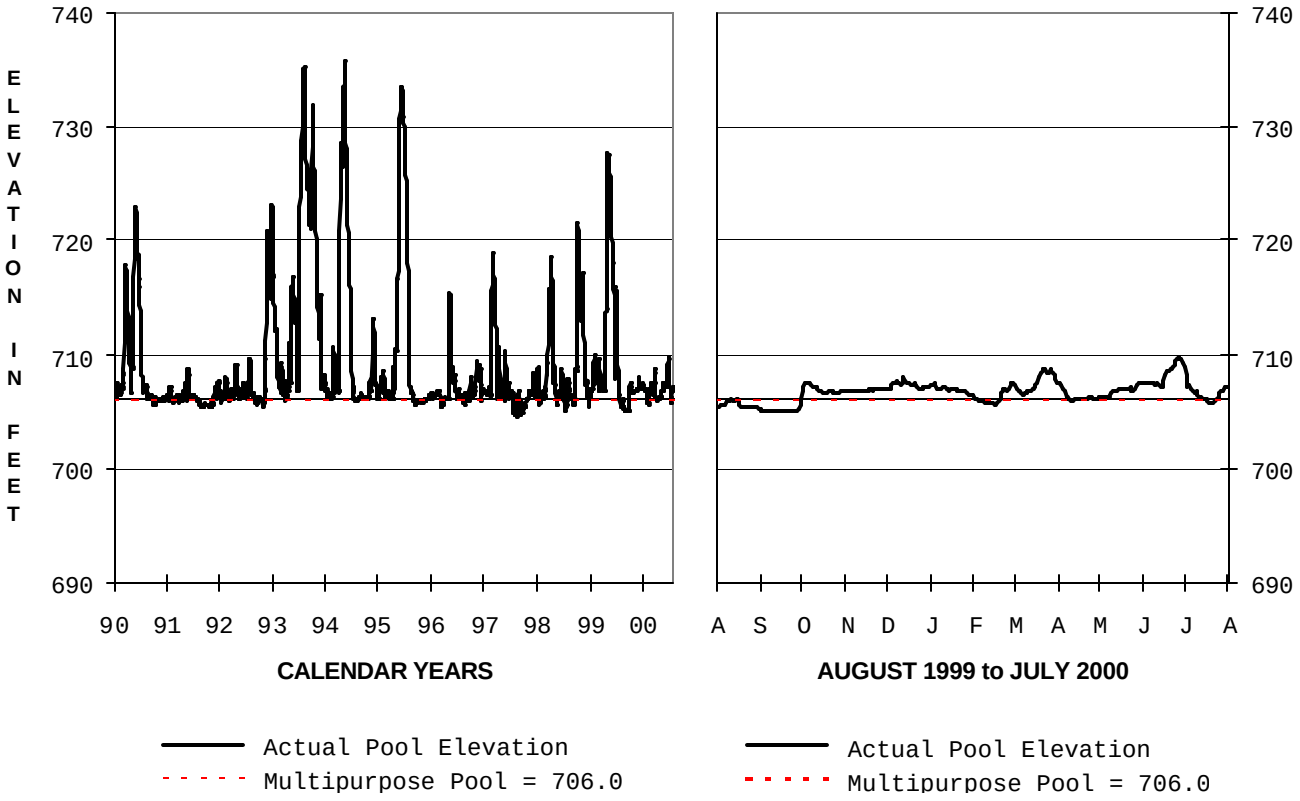


HARLAN COUNTY LAKE ANNUAL INFLOW



HARRY S. TRUMAN RESERVOIR
1999-2000 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

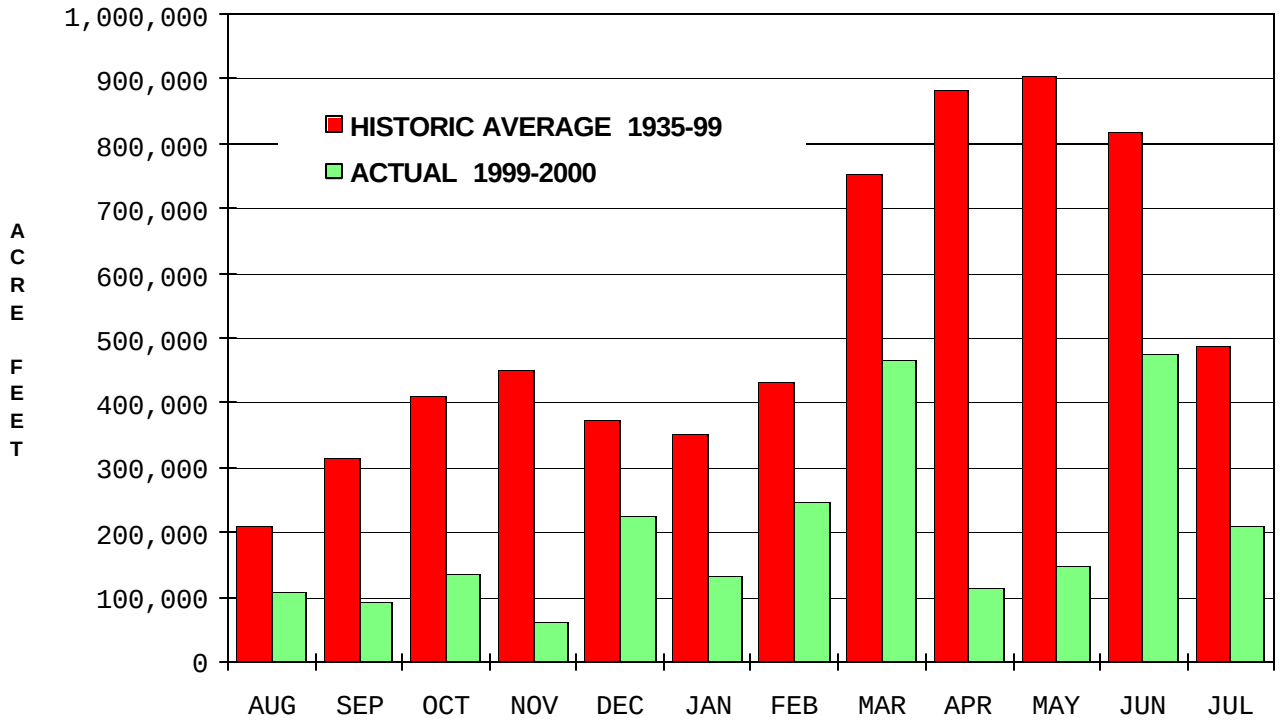


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
705.45 1 Aug 99	**707.17 31 Jul 00**	**709.75 26 Jun 00**	**704.99 18 Sep 99**	**738.72 12 Oct 86**	**703.42 10 Apr 81**

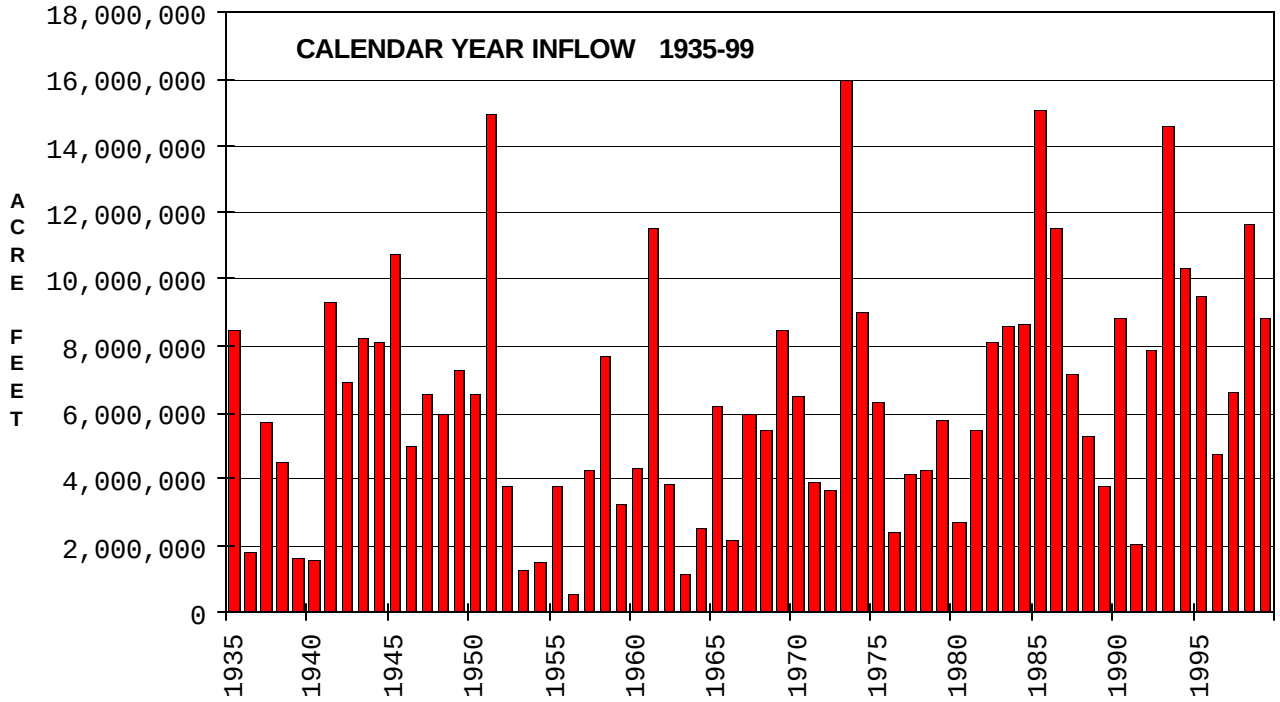
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
22,000 23 Jun 00	**2,405,723 14,315,776 AF previous period**	**24,983 2 Jul 00**	**0 Several periods**

Listed outflows include turbine releases and spill to the river. Spill requirement varies during the year.

HARRY S. TRUMAN RESERVOIR MONTHLY INFLOW

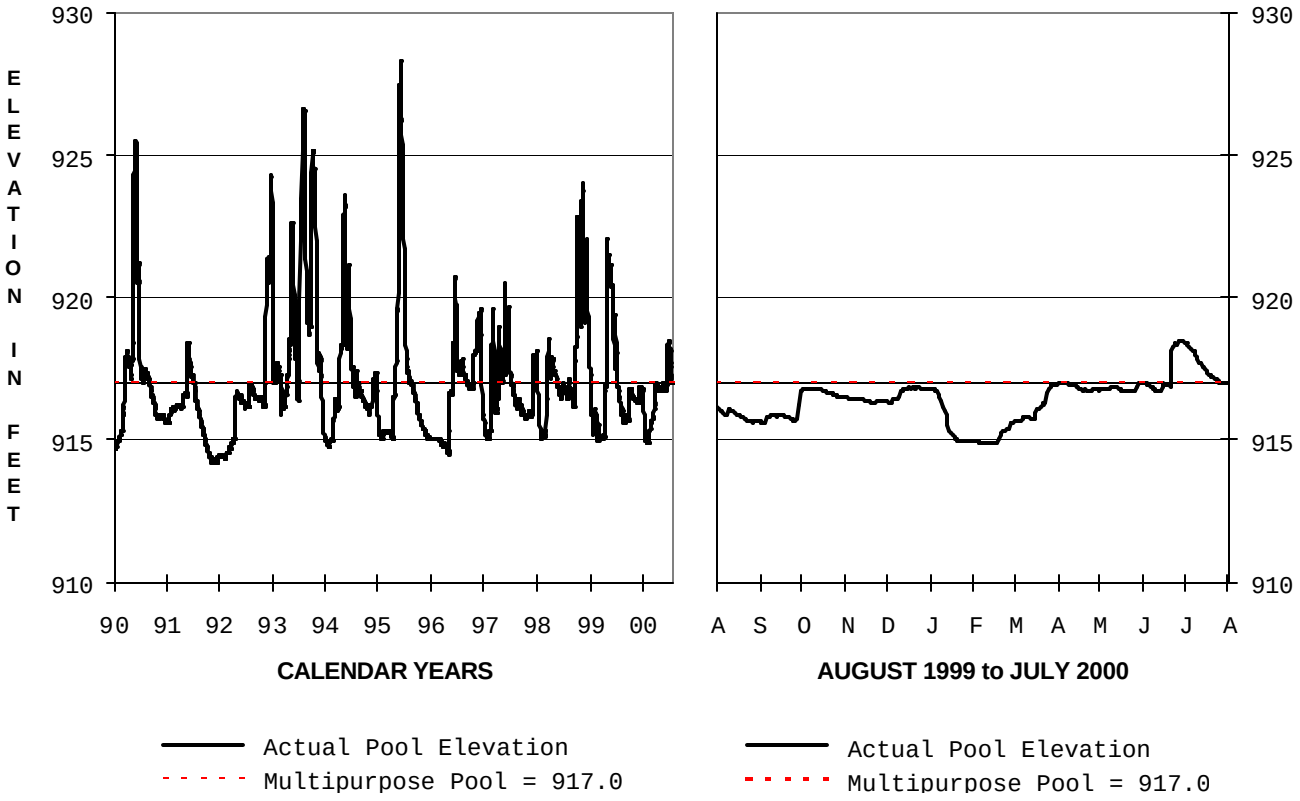


HARRY S. TRUMAN RESERVOIR ANNUAL INFLOW



HILLSDALE LAKE
1999-2000 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

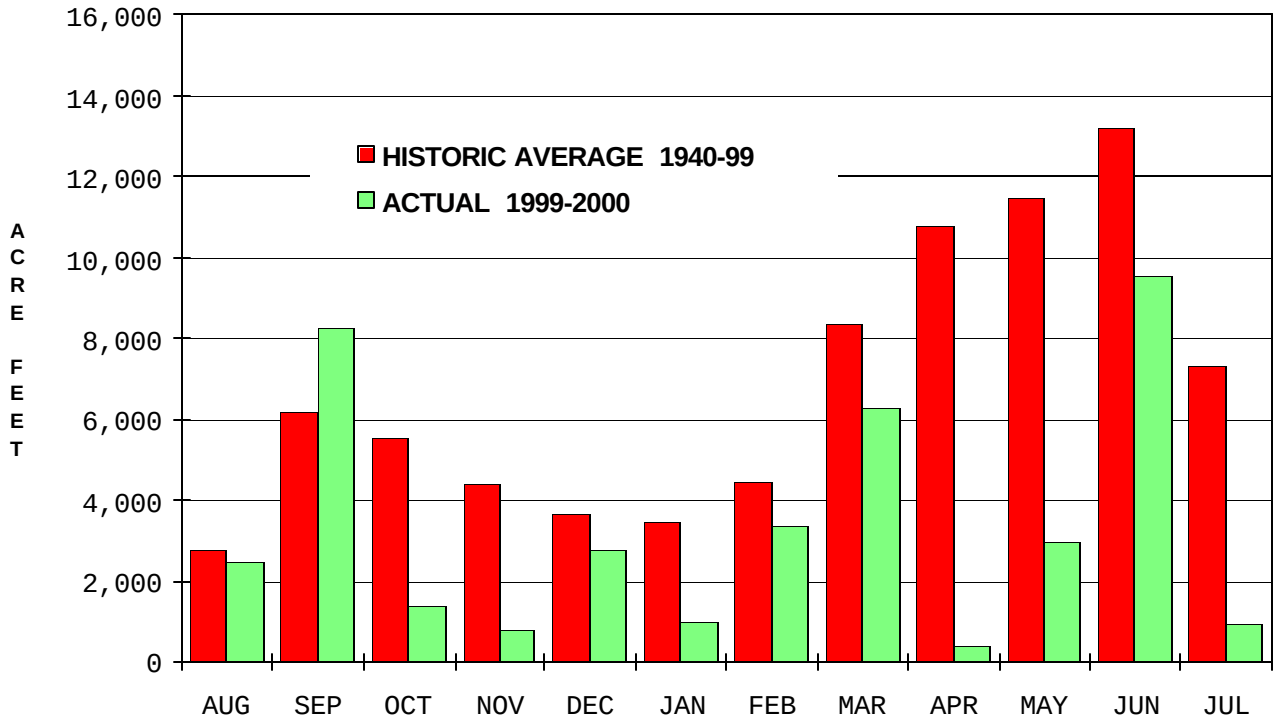


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
916.11 1 Aug 99	**916.97 31 Jul 00**	**918.48 27-29 Jun 00**	**914.89 15-17 Feb 00**	**928.51 21 Oct 86**	**904.97 14-15 Nov 87**

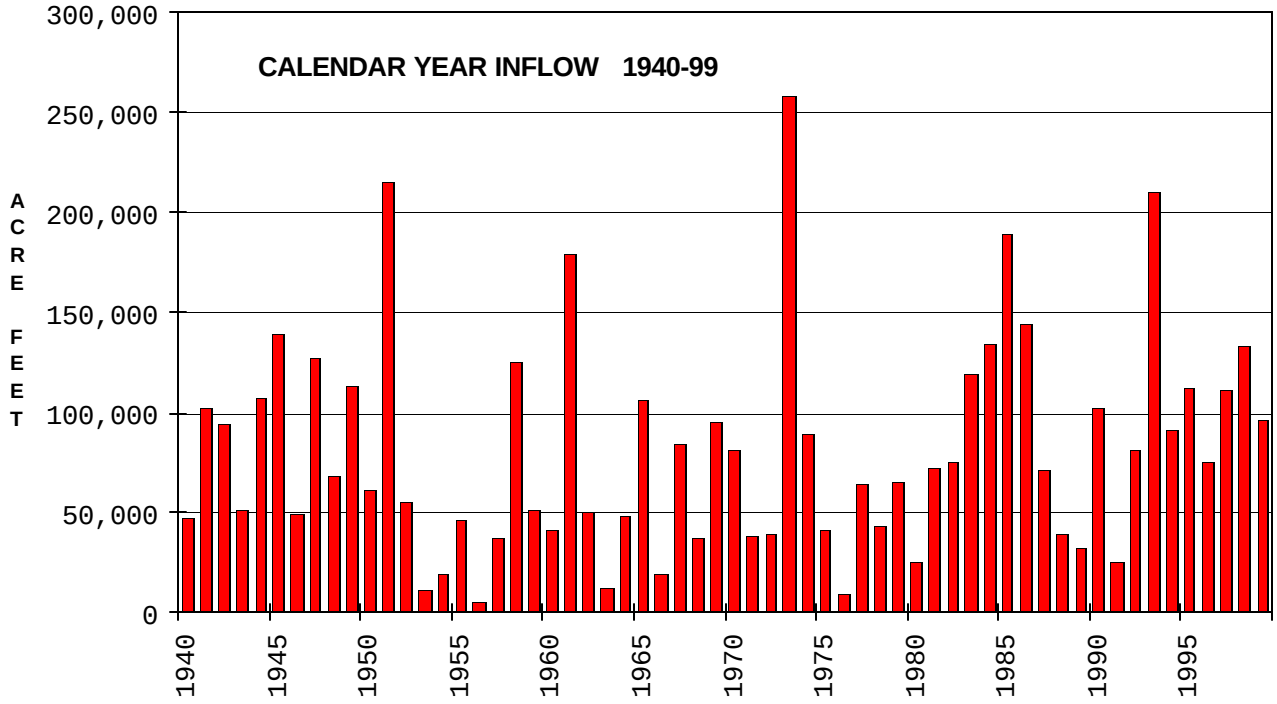
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
2,500 21 Jun 00	**39,837 159,976 AF previous period**	**400 7-14 Jan 00**	**0 Several periods**

Listed outflows are to the river. Releases cut to 0 only for maintenance. Normal min release is 3-24 cfs.

HILLSDALE LAKE MONTHLY INFLOW

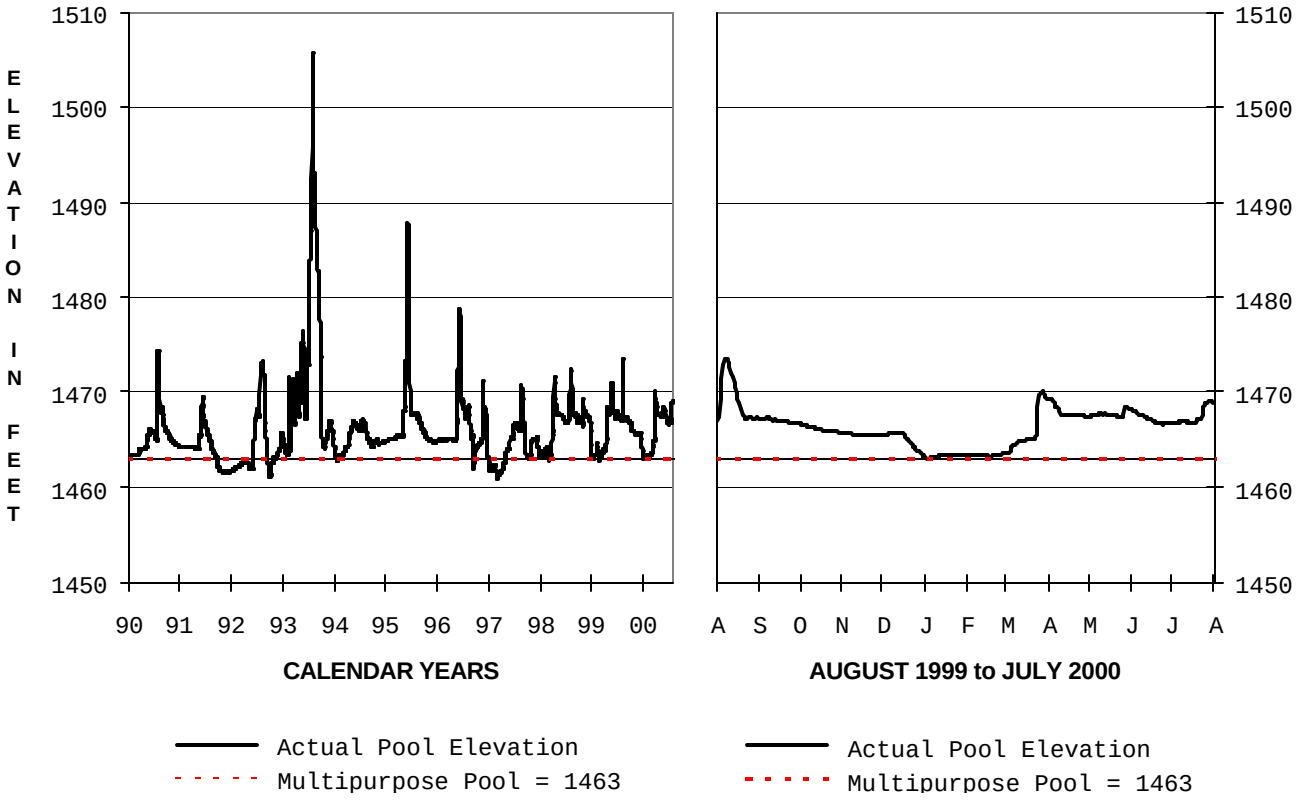


HILLSDALE LAKE ANNUAL INFLOW



KANOPOLIS LAKE
1999-2000 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

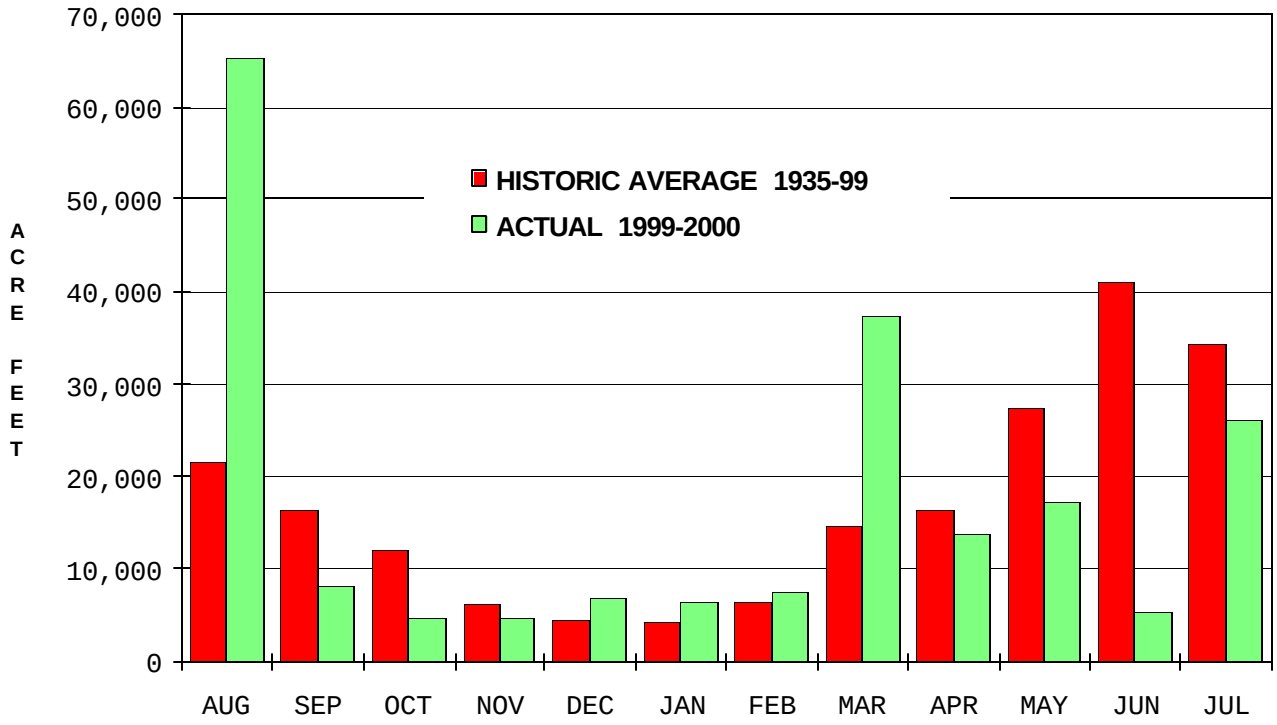


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1466.98 1 Aug 99	**1468.93 31 Jul 00**	**1473.61 7 Aug 99**	**1463.05 2 Jan 00**	**1506.98 14 Jul 51**	**1452.55 11 Dec 88**

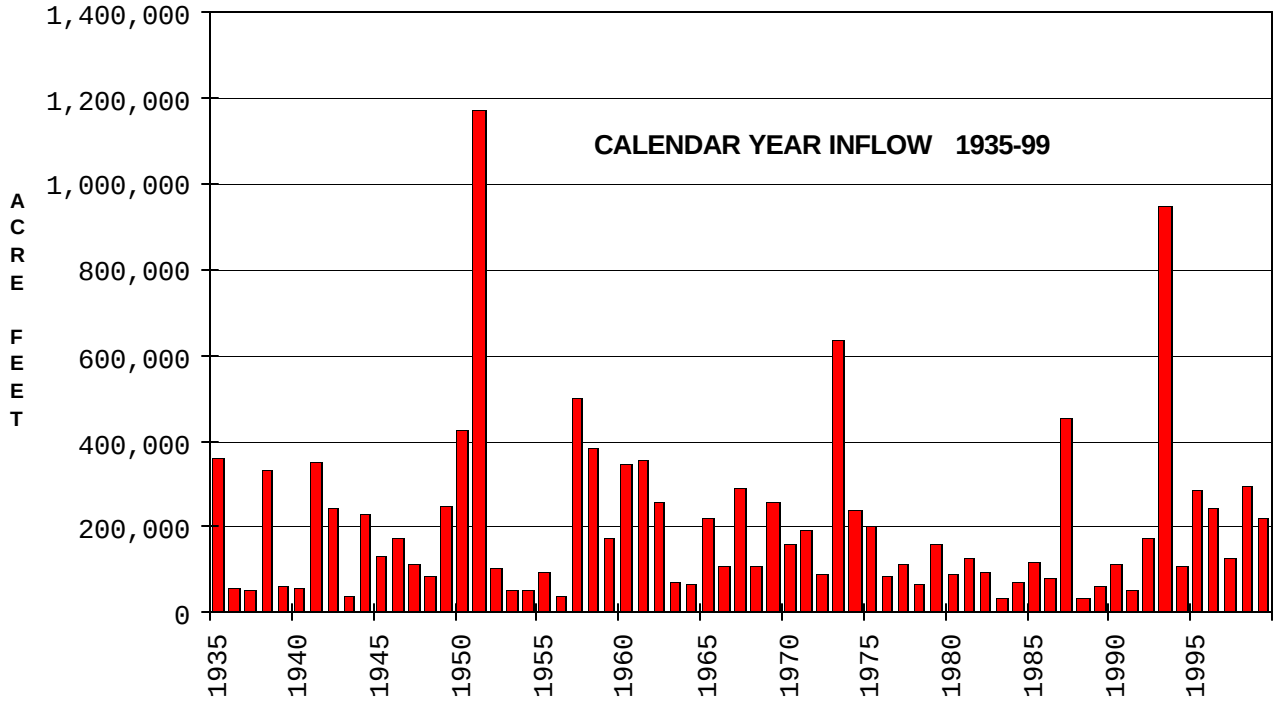
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
6,350 24 Mar 00	**203,227 244,461 AF previous period**	**2,057 7 Aug 99**	**52 15 Mar 00**

Listed outflows include releases to the river from both the gates and the uncontrolled notch.

KANOPOLIS LAKE MONTHLY INFLOW

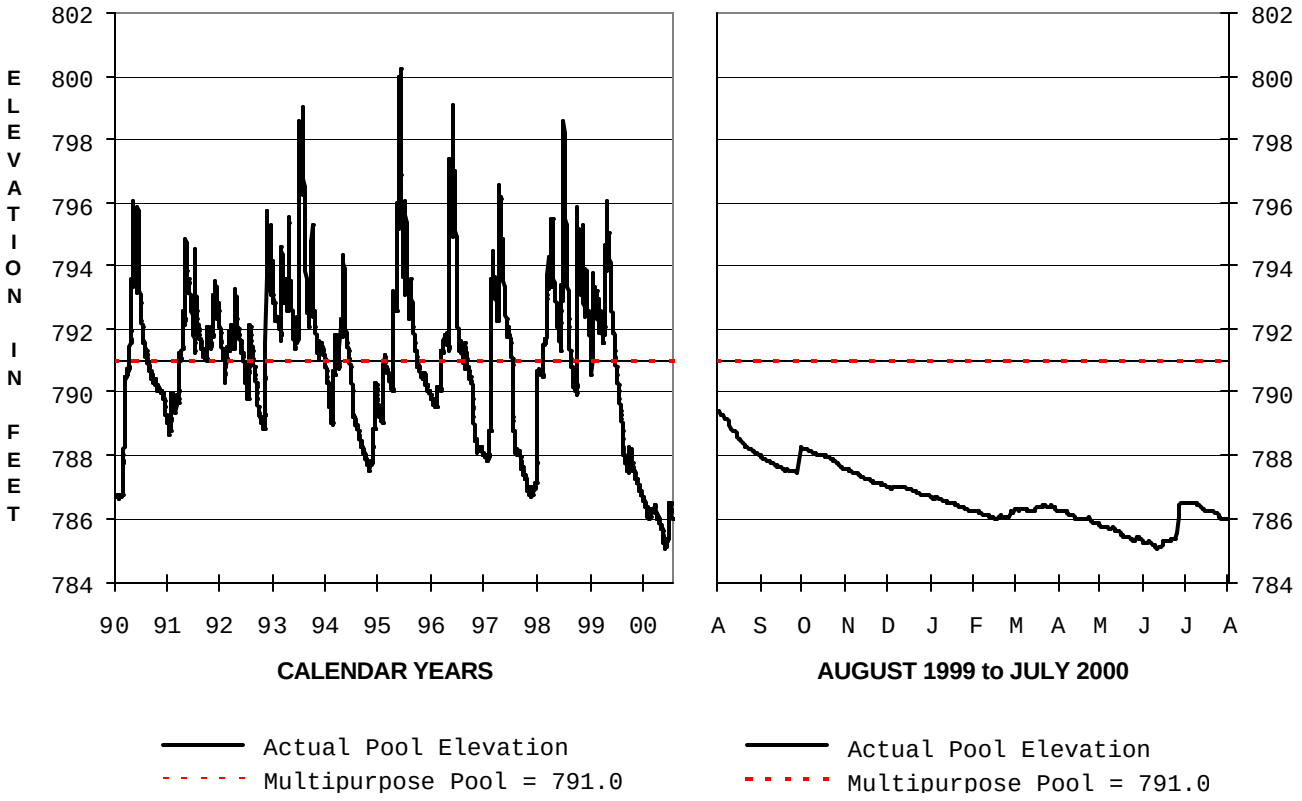


KANOPOLIS LAKE ANNUAL INFLOW



LONG BRANCH LAKE
1999-2000 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

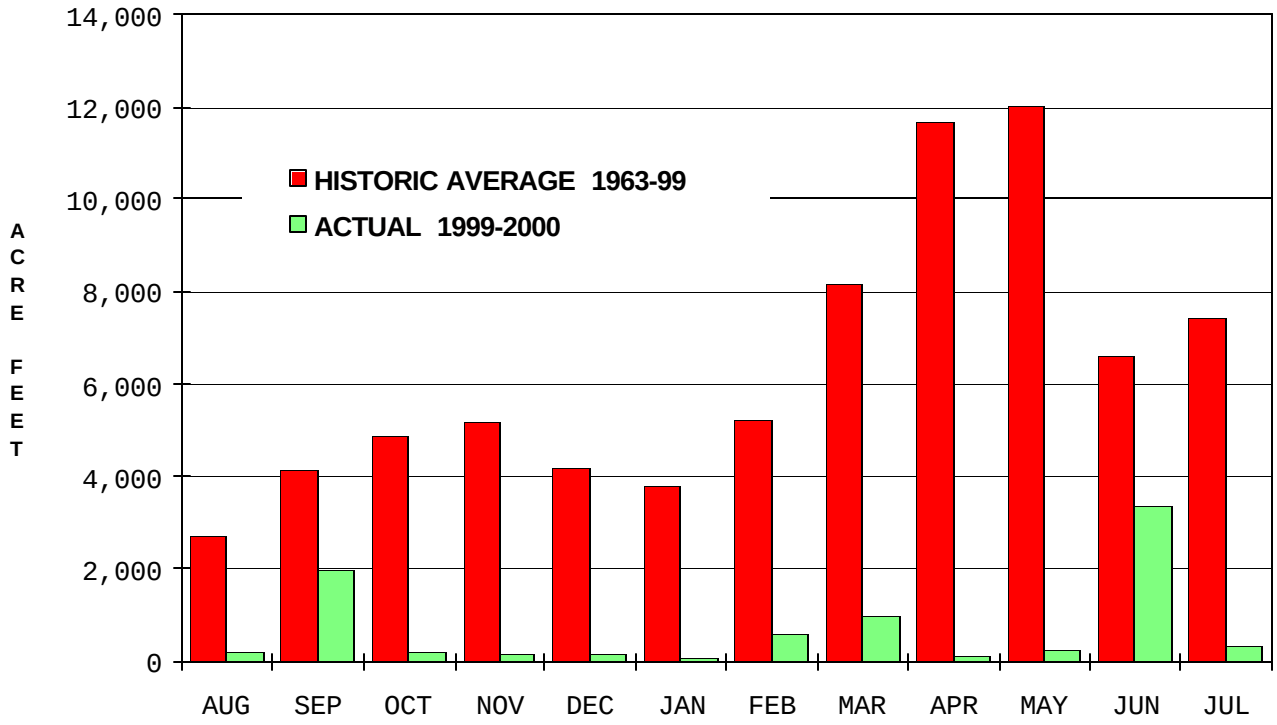


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
789.42 1 Aug 99	**786.00 31 Jul 00**	**789.42 1 Aug 99**	**785.06 10 Jun 00**	**800.40 28 May 95**	**785.06 10 Jun 00**

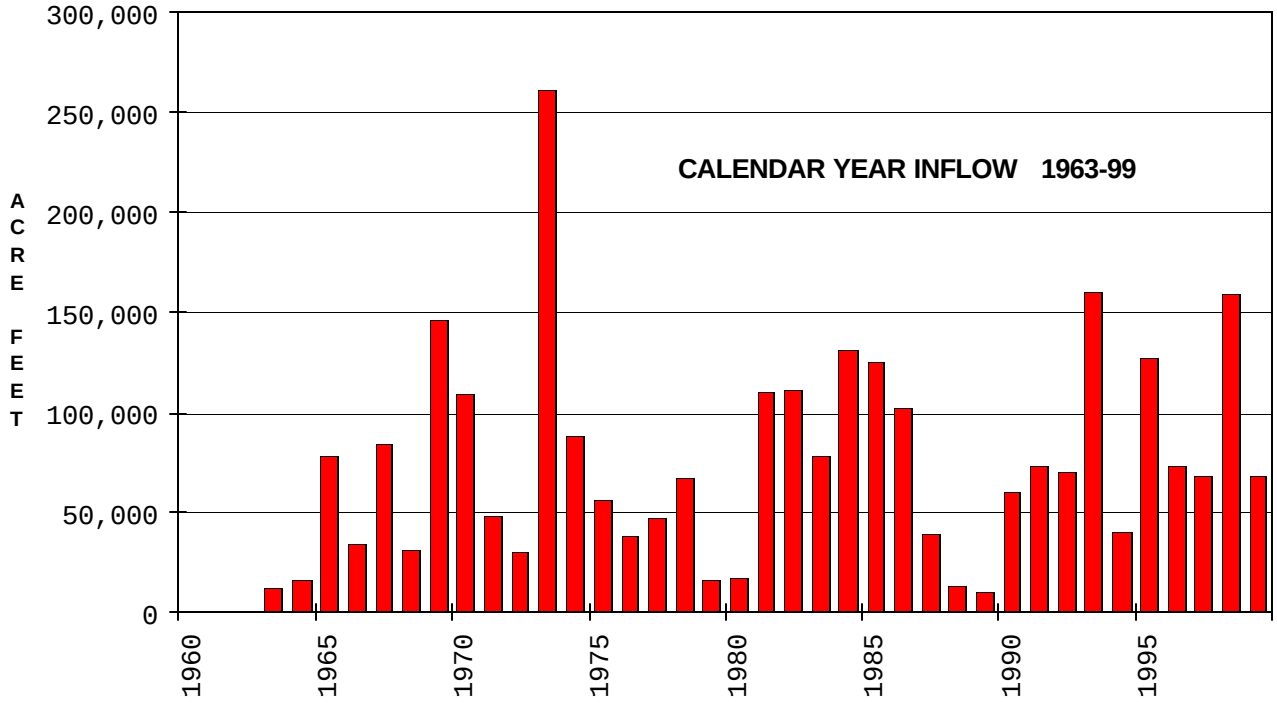
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
425 28 Sep 99	**8,370 119,725 AF previous period**	**50 1-20 Aug 99**	**0 22-25 Aug 99**

Listed outflows are river releases only. Min daily outflow of 0 for periodic inspection. Normal min is 7 cfs.

LONG BRANCH LAKE MONTHLY INFLOW

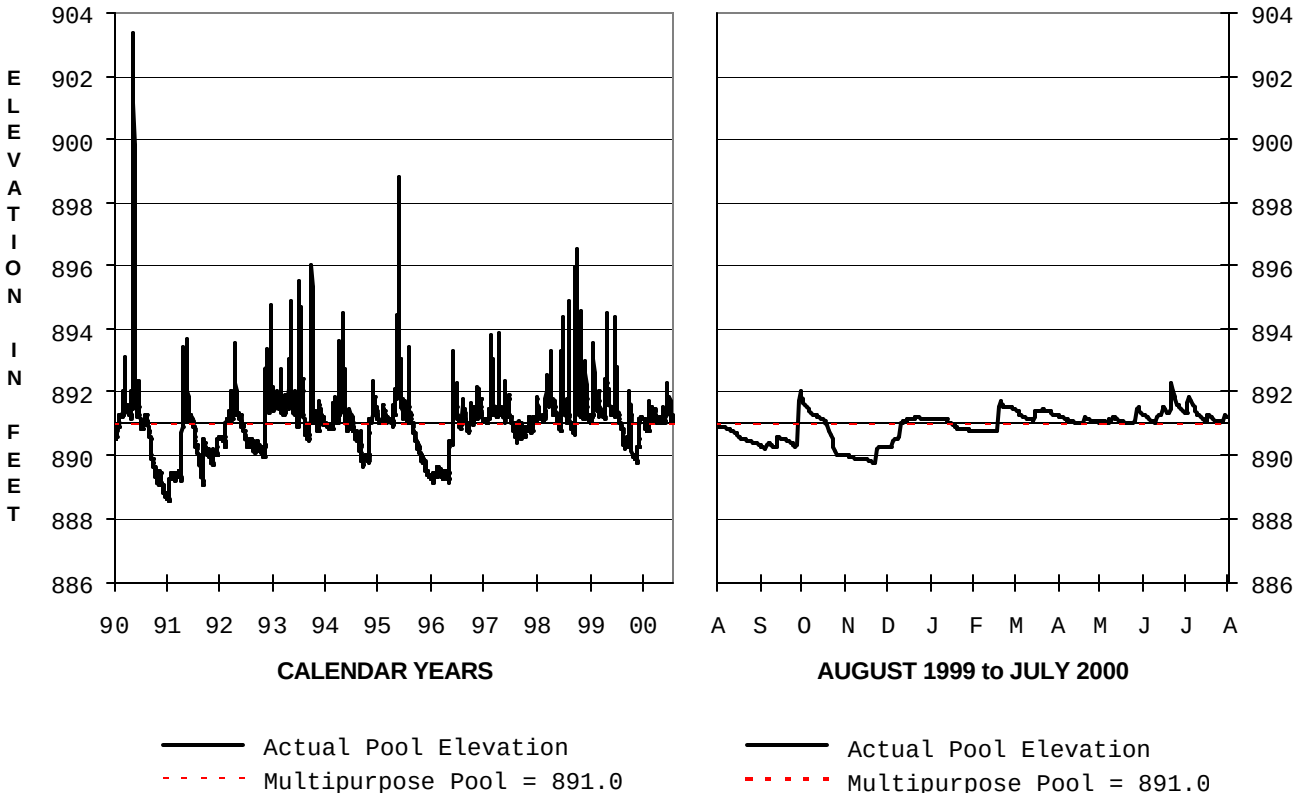


LONG BRANCH LAKE ANNUAL INFLOW



LONGVIEW LAKE
1999-2000 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

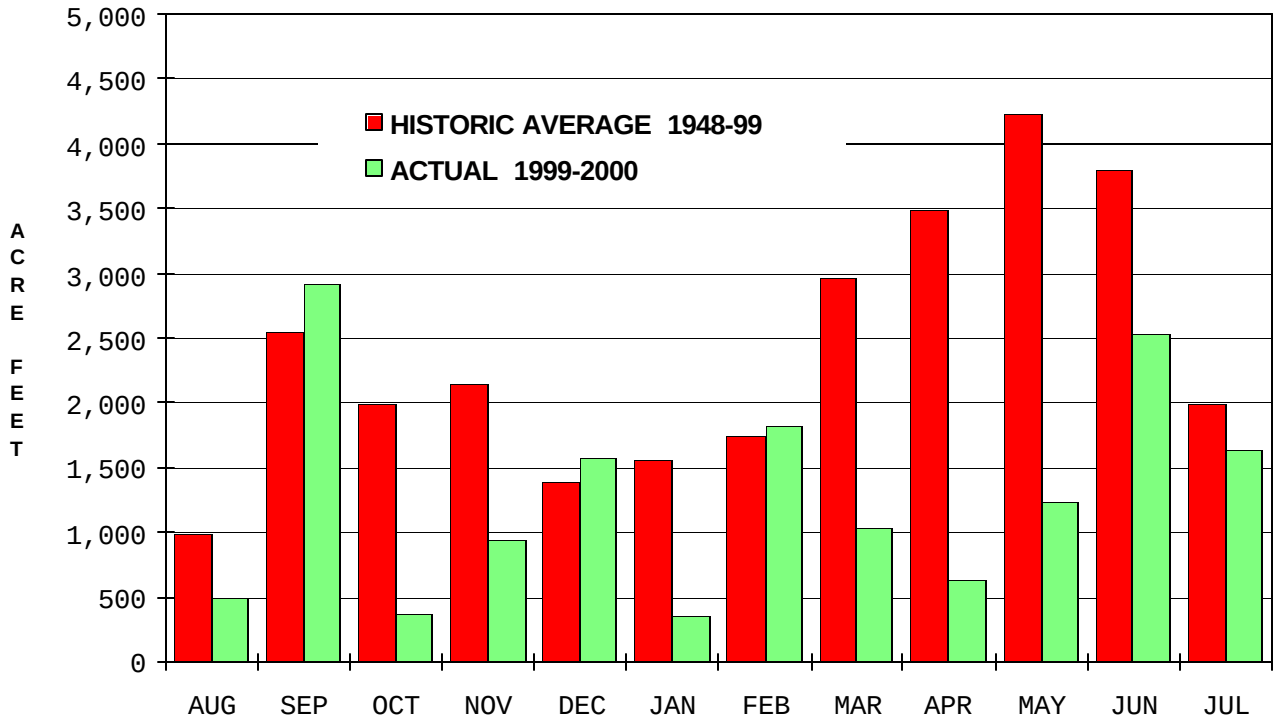


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
890.92 1 Aug 99	**891.23 31 Jul 00**	**892.32 21 Jun 00**	**889.79 22 Nov 99**	**903.37 16 May 90**	**888.08 14 Sep 88**

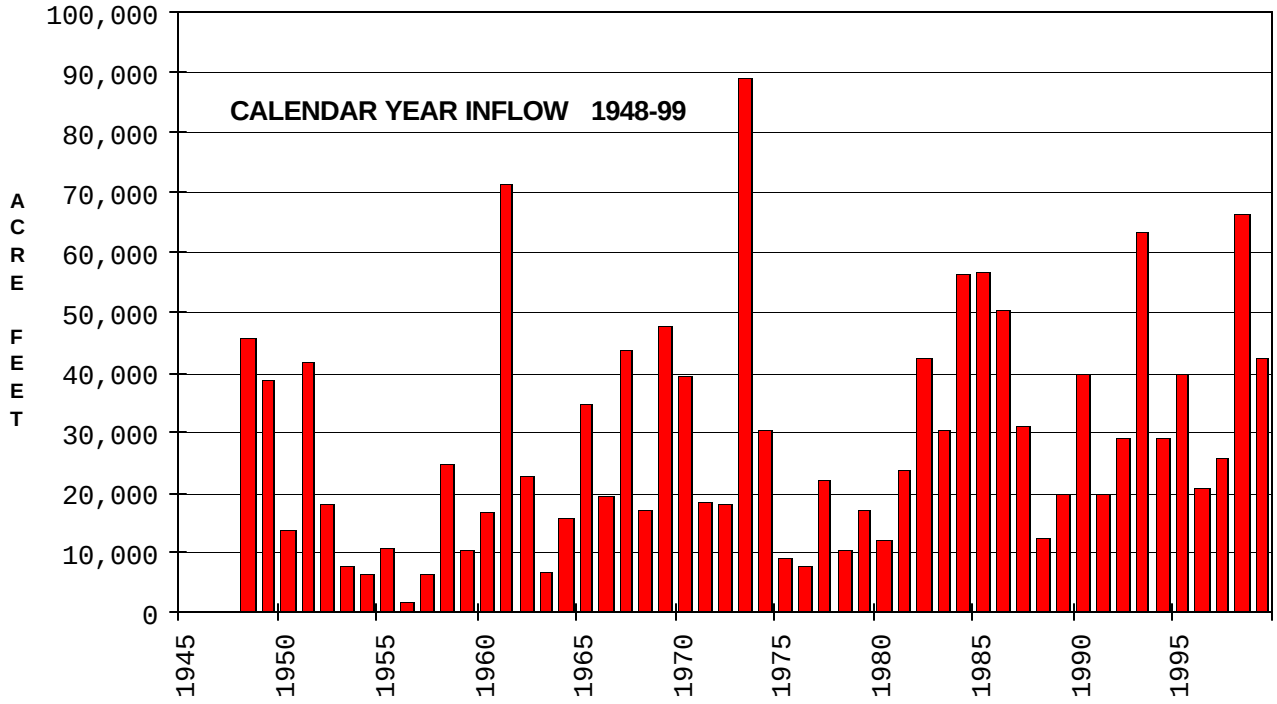
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
650 28 Sep 99	**15,515 69,118 AF previous period**	**189 22 Jun 00**	**8 Most of the year**

Listed outflows include releases to the river from both the gate (8 cfs) and the uncontrolled notch.

LONGVIEW LAKE MONTHLY INFLOW

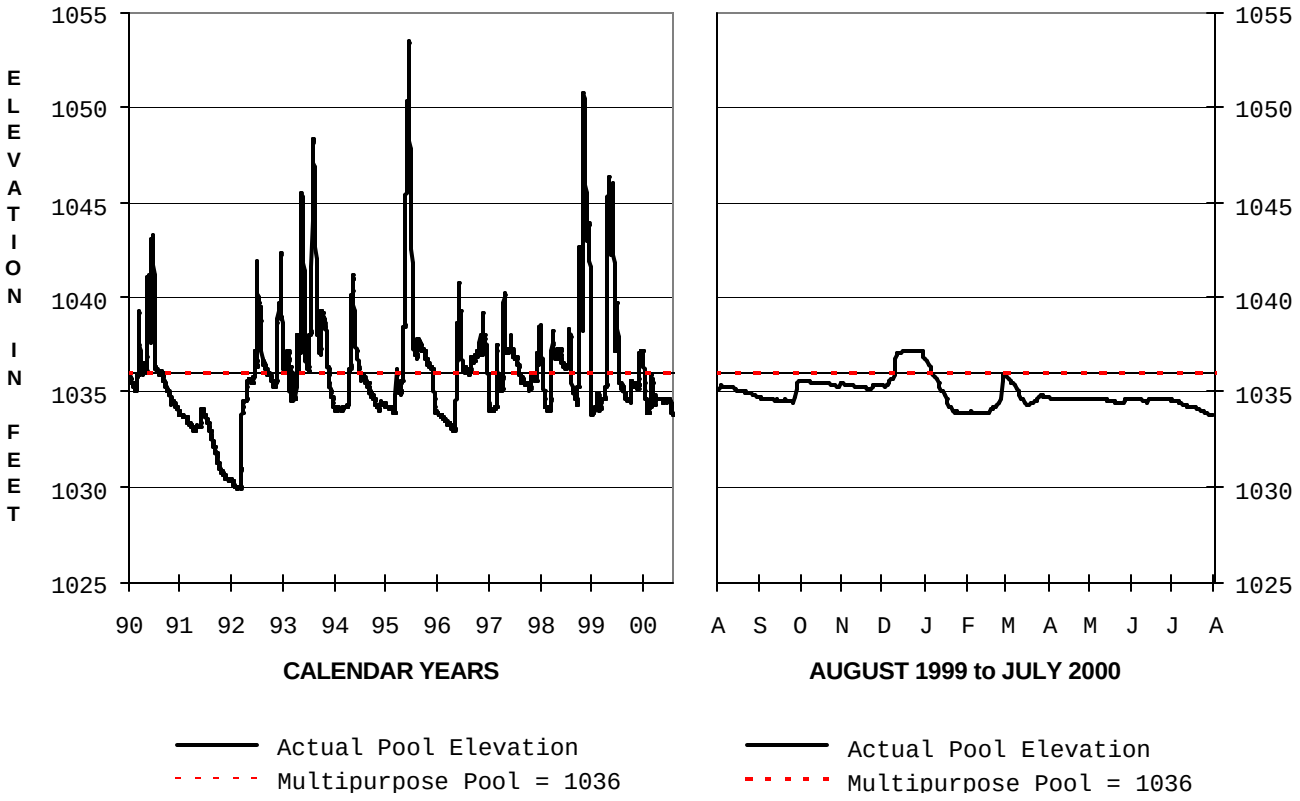


LONGVIEW LAKE ANNUAL INFLOW



MELVERN LAKE
1999-2000 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

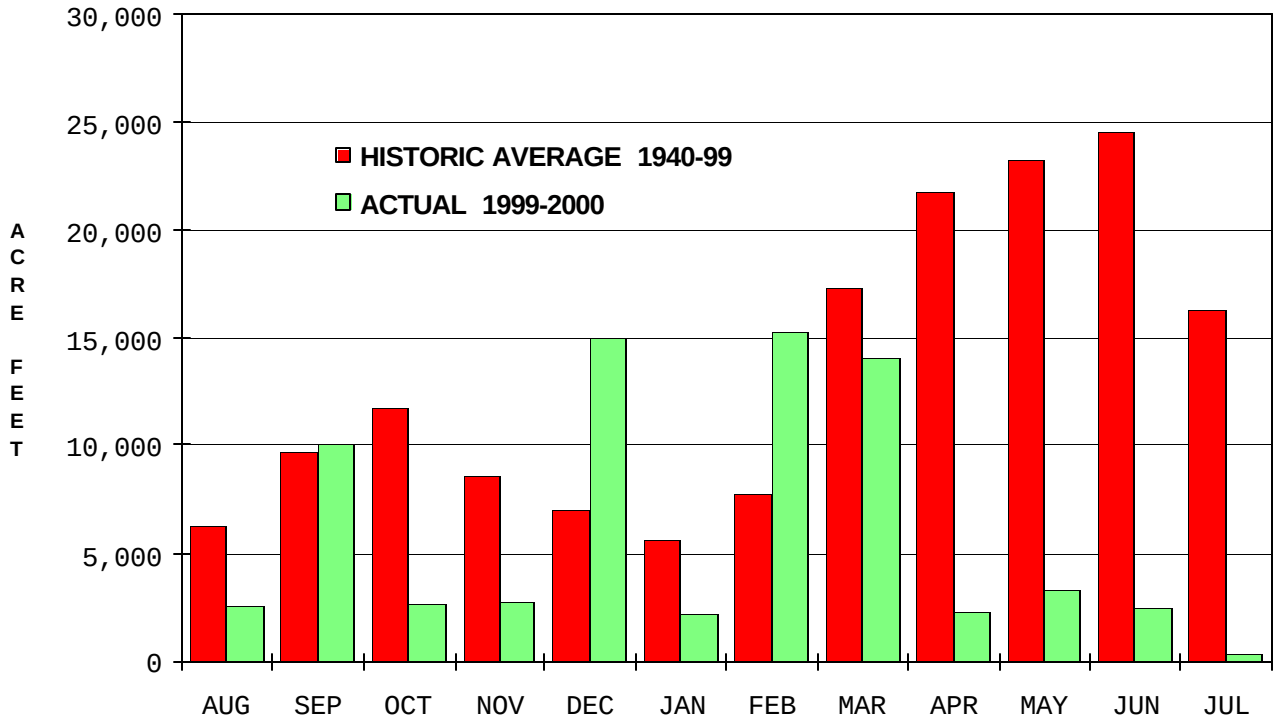


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1035.23 1 Aug 99	**1033.80 31 Jul 00**	**1037.25 28 Dec 99**	**1033.80 31 Jul 00**	**1053.45 13 Jun 95**	**1029.87 11 Feb 92**

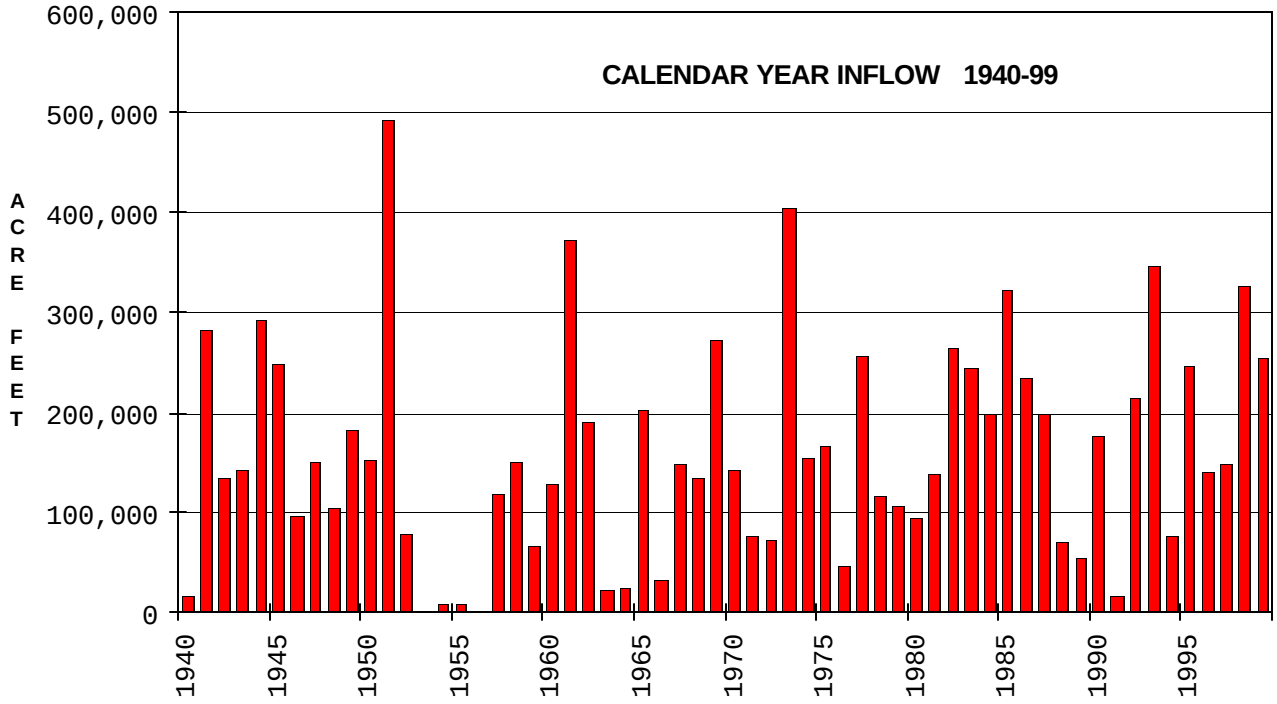
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
2,500 10 Dec 99	**73,021 434,101 AF previous period**	**500, 28 Dec to 21 Jan 28 Feb to 15 Mar 00**	**0, 15 Oct 99 18-22 Oct 99**

All outflows to river. Min daily release reduced to 0 for maintenance only. Min release normally 20 cfs.

MELVERN LAKE MONTHLY INFLOW

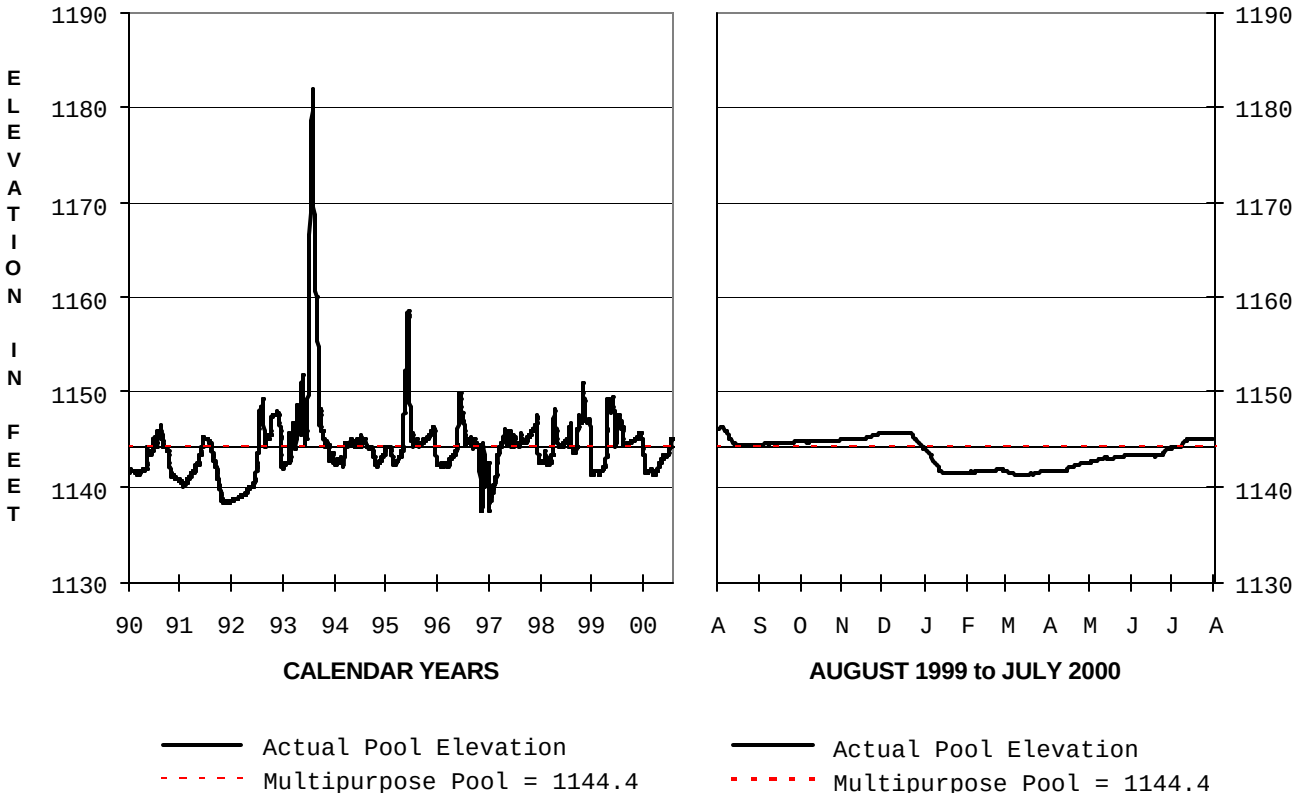


MELVERN LAKE ANNUAL INFLOW



MILFORD LAKE
1999-2000 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

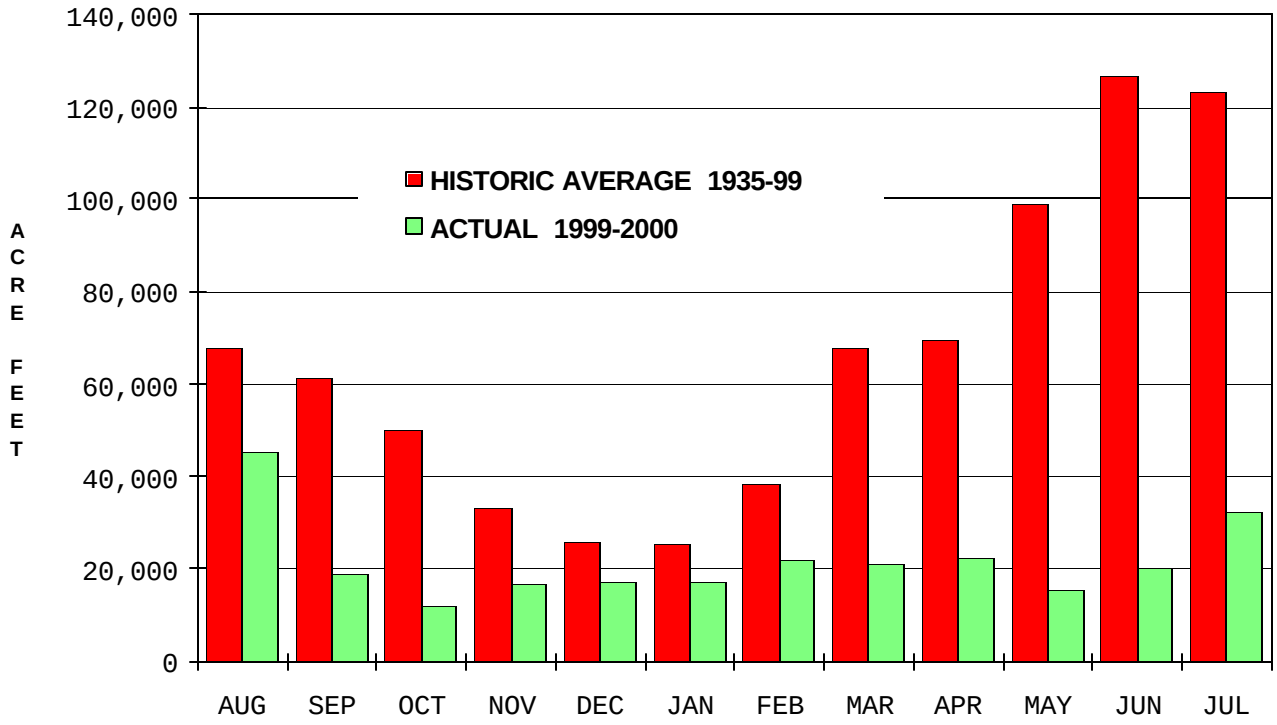


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1146.12 1 Aug 99	**1145.24 31 Jul 00**	**1146.42 4 Aug 99**	**1141.24 8 Mar 00**	**1181.94 25 Jul 93**	**1137.30 26 Feb 88**

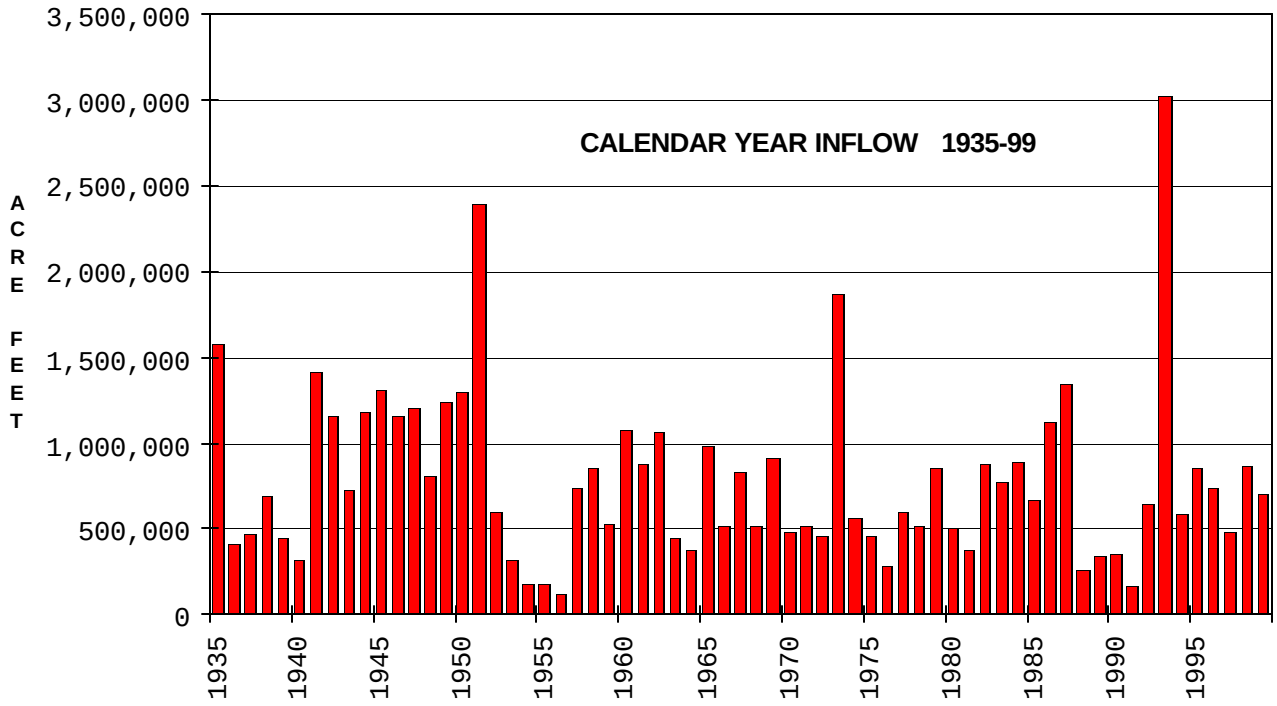
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
3,500 3 Aug 99	**260,308 950,578 AF previous period**	**2,500 4-12 Aug 99**	**25 Normal min release**

All outflows are to the river. Releases reduced to 0 for a few hours at a time for maintenance.

MILFORD LAKE MONTHLY INFLOW

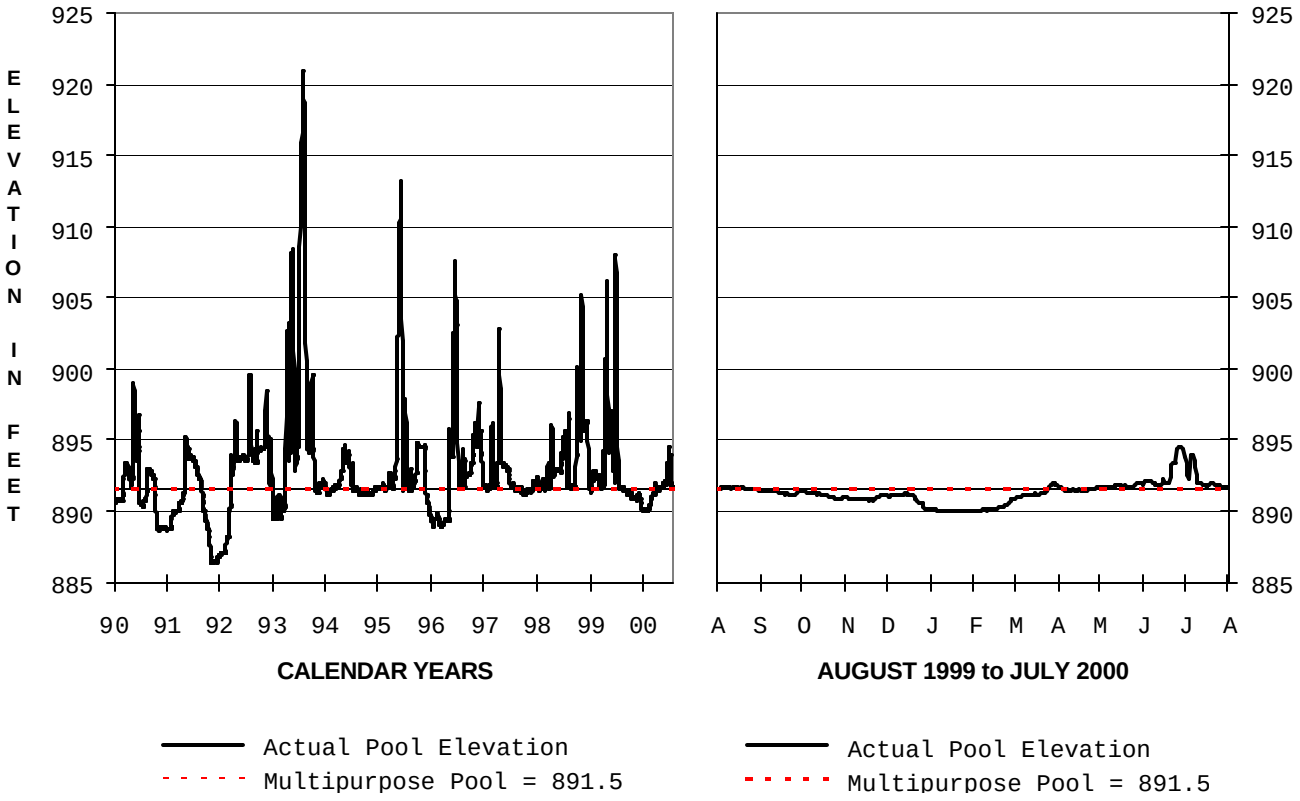


MILFORD LAKE ANNUAL INFLOW



PERRY LAKE
1999-2000 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

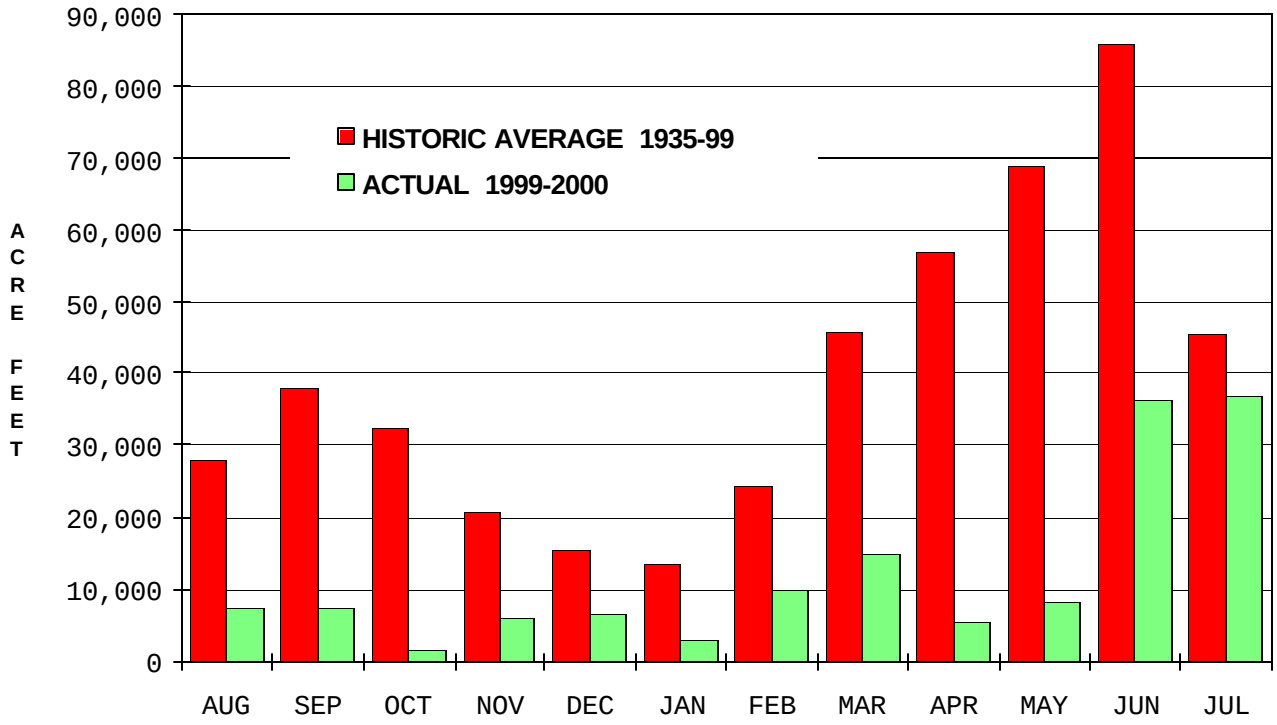


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
891.55 1 Aug 99	**891.74 31 Jul 00**	**894.51 28 Jun 00**	**890.03 15 Jan 00**	**920.89 25 Jul 93**	**886.30 14 Nov 91**

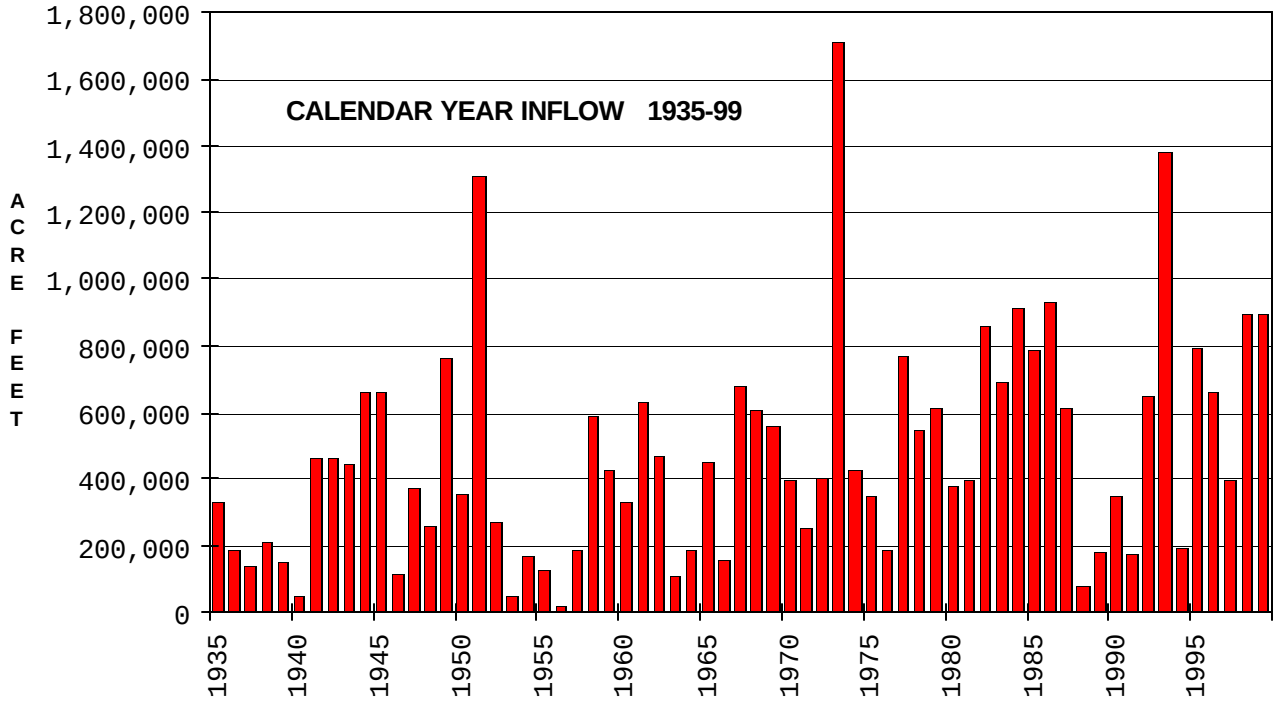
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
9,200 5 Jul 00	**143,297 1,376,796 AF previous period**	**3,000, 29 Jun to 3 Jul and 5-10 Jul 00**	**21 20 Jun 00**

Outflows cut to 0 for maintenance brief times in Jun and Jul 00. Normal minimum release is 25 cfs.

PERRY LAKE MONTHLY INFLOW

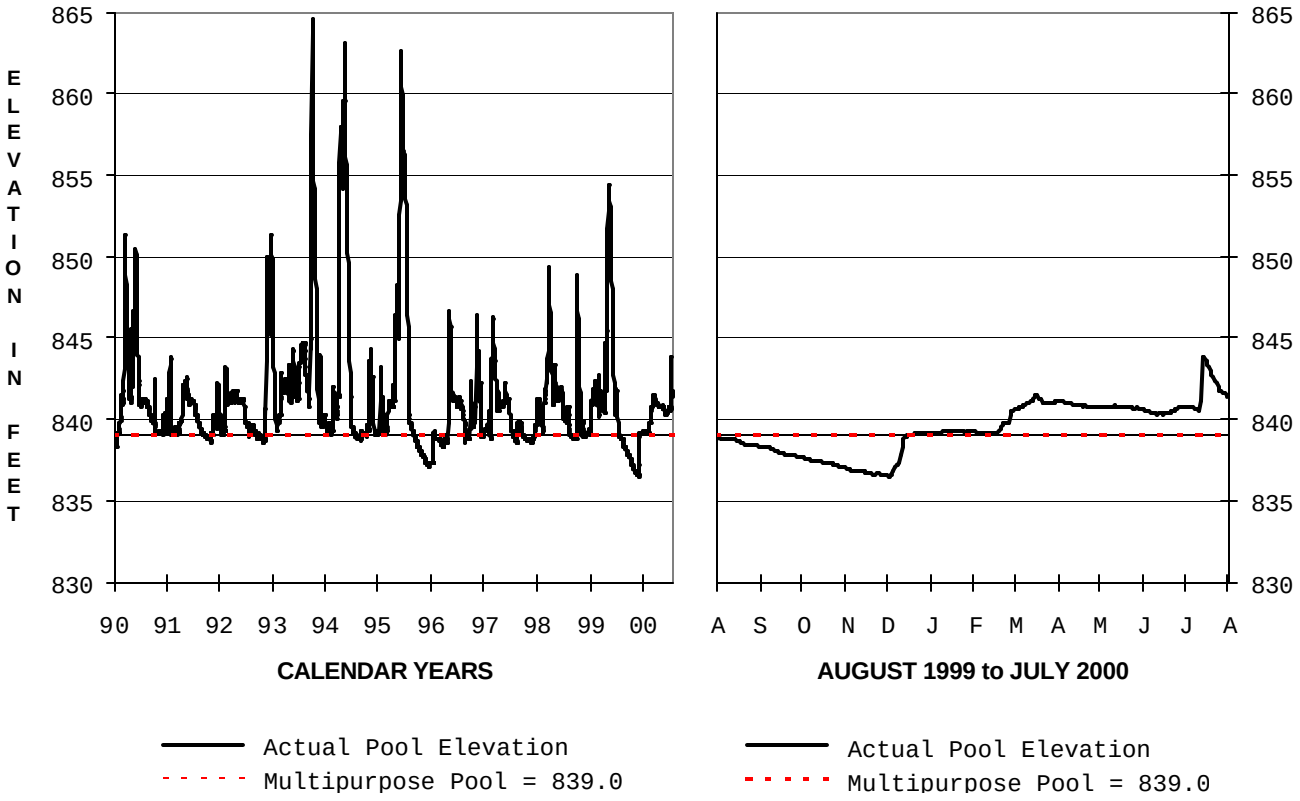


PERRY LAKE ANNUAL INFLOW



POMME DE TERRE LAKE
1999-2000 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

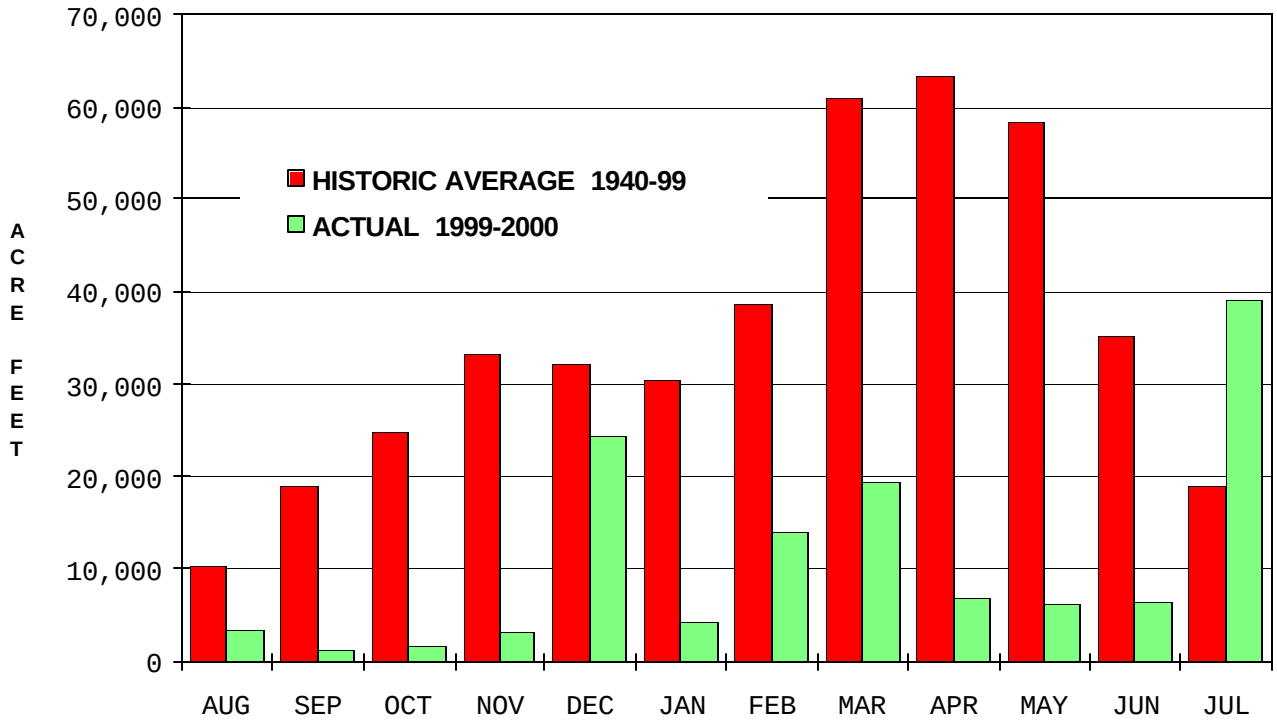


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
838.89 1 Aug 99	**841.41 31 Jul 00**	**843.91 13-14 Jul 00**	**836.48 2 Dec 99**	**864.58 27 Sep 93**	**835.61 3 Mar 64**

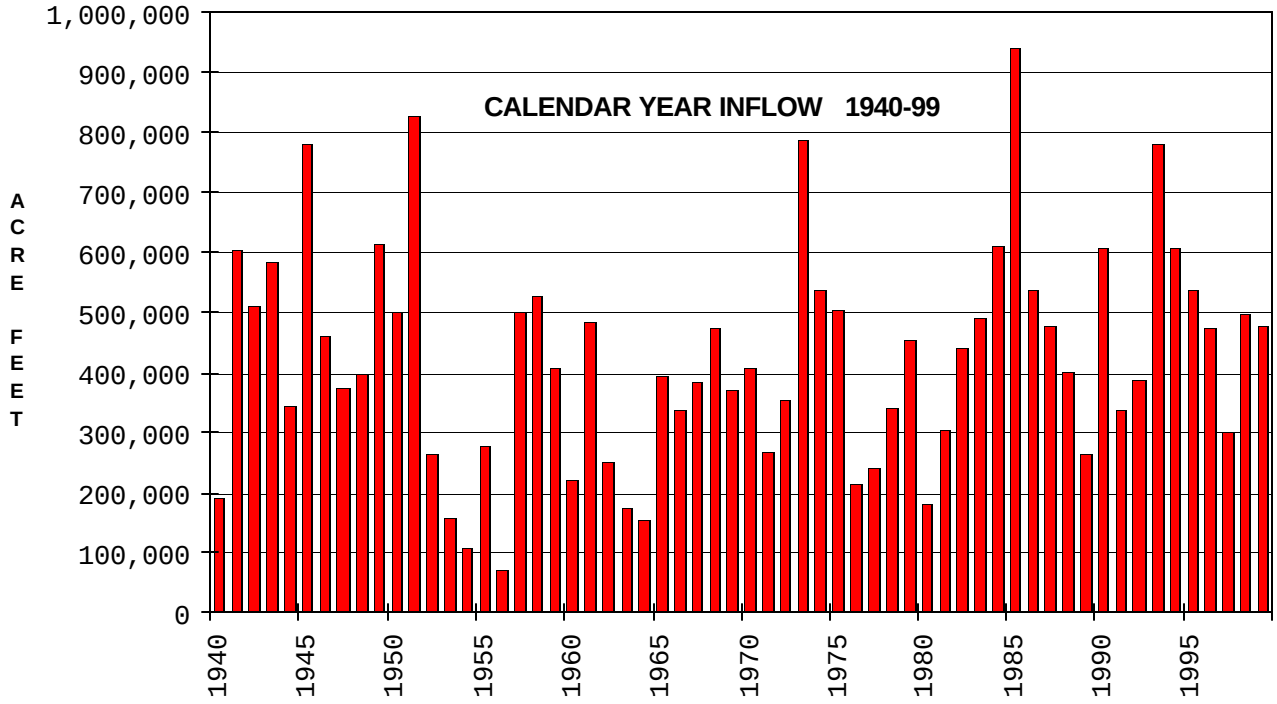
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
11,000 13 Jul 00	**130,106 589,190 AF previous period**	**1,000, 16-20 Mar 00 and 13-24 Jul 00**	**50 Most of the year**

All outflows are to the river. Normal minimum release is 50 to 100 cfs, varying by season and pool level.

POMME DE TERRE LAKE MONTHLY INFLOW

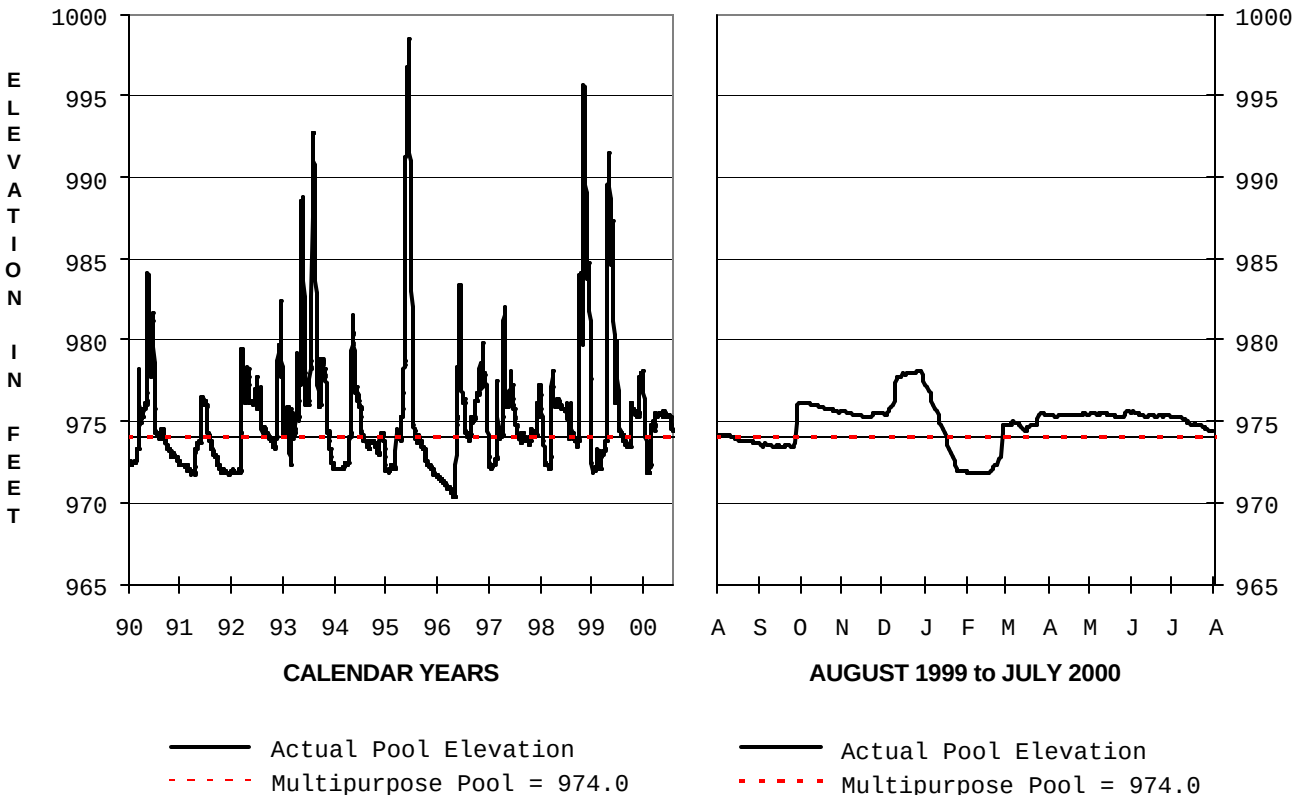


POMME DE TERRE LAKE ANNUAL INFLOW



POMONA LAKE
1999-2000 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

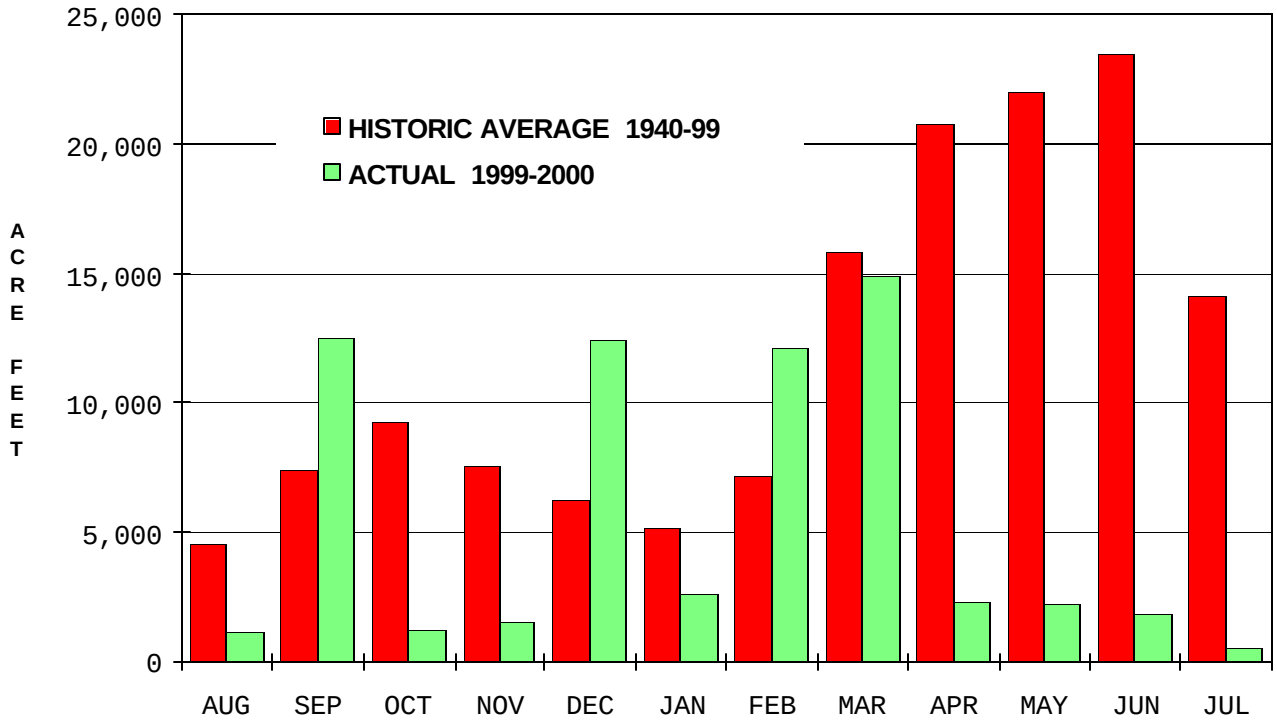


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
974.12 1 Aug 99	**974.40 31 Jul 00**	**978.06 28 Dec 99**	**971.78 17 Feb 00**	**998.40 12-13 Jun 95**	**969.62 30 Mar 67**

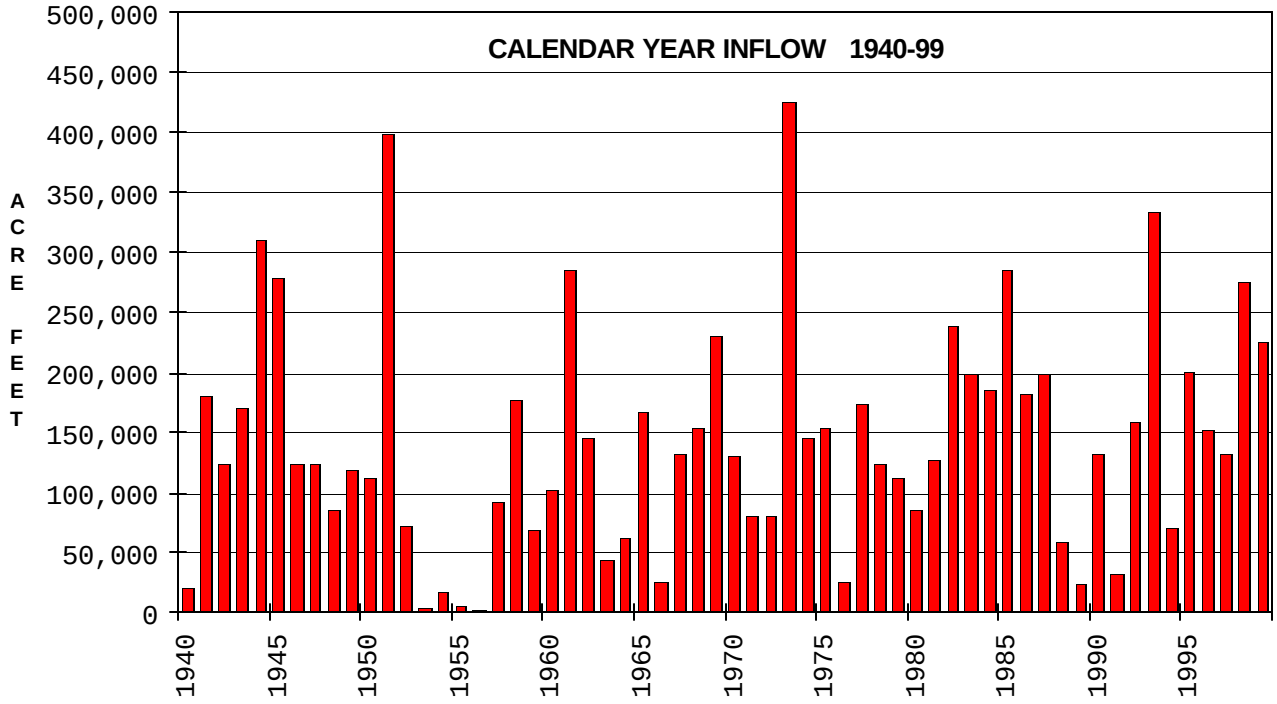
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
2,350 28 Sep 99	**65,068 401,067 AF previous period**	**500 28 Dec 99 to 24 Jan 00**	**15 Normal min release**

All outflows to the river. Water supply releases were made in addition to min releases during summer.

POMONA LAKE MONTHLY INFLOW

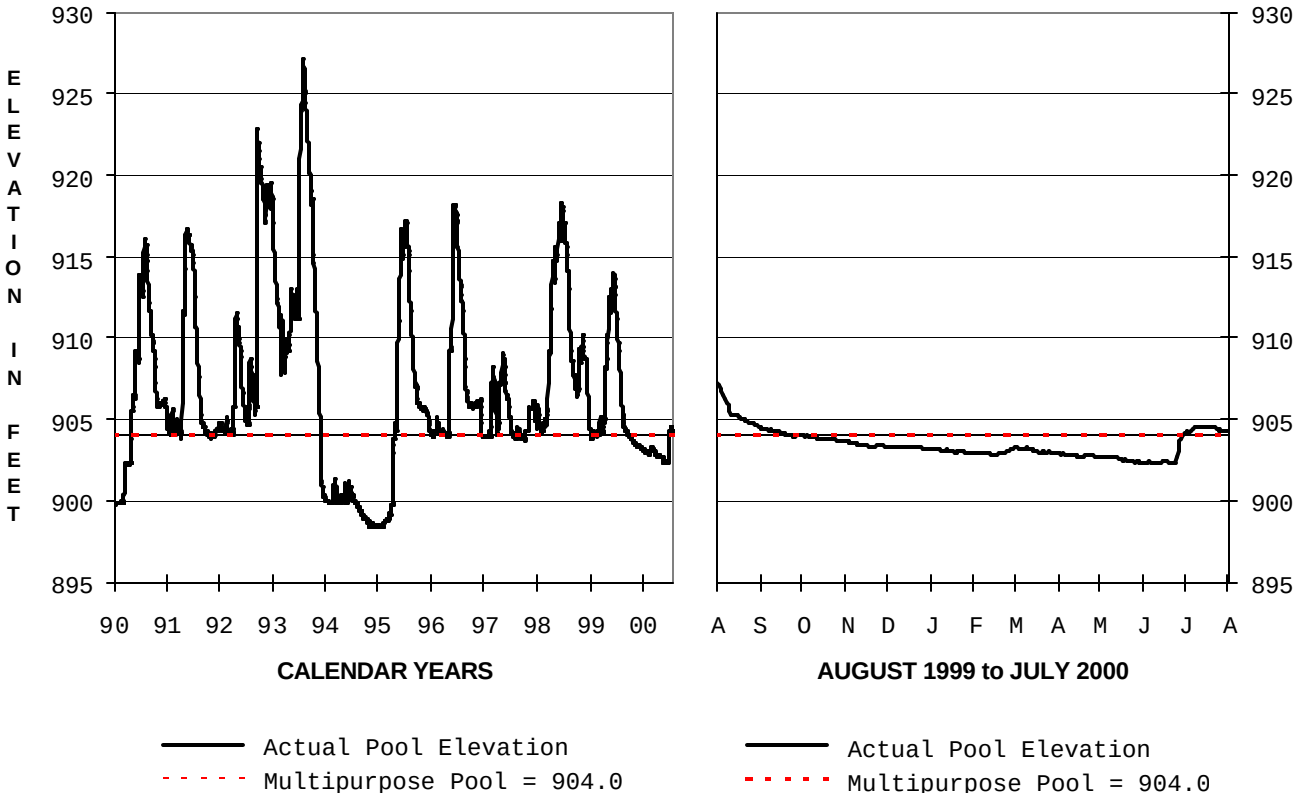


POMOMA LAKE ANNUAL INFLOW



RATHBUN LAKE
1999-2000 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

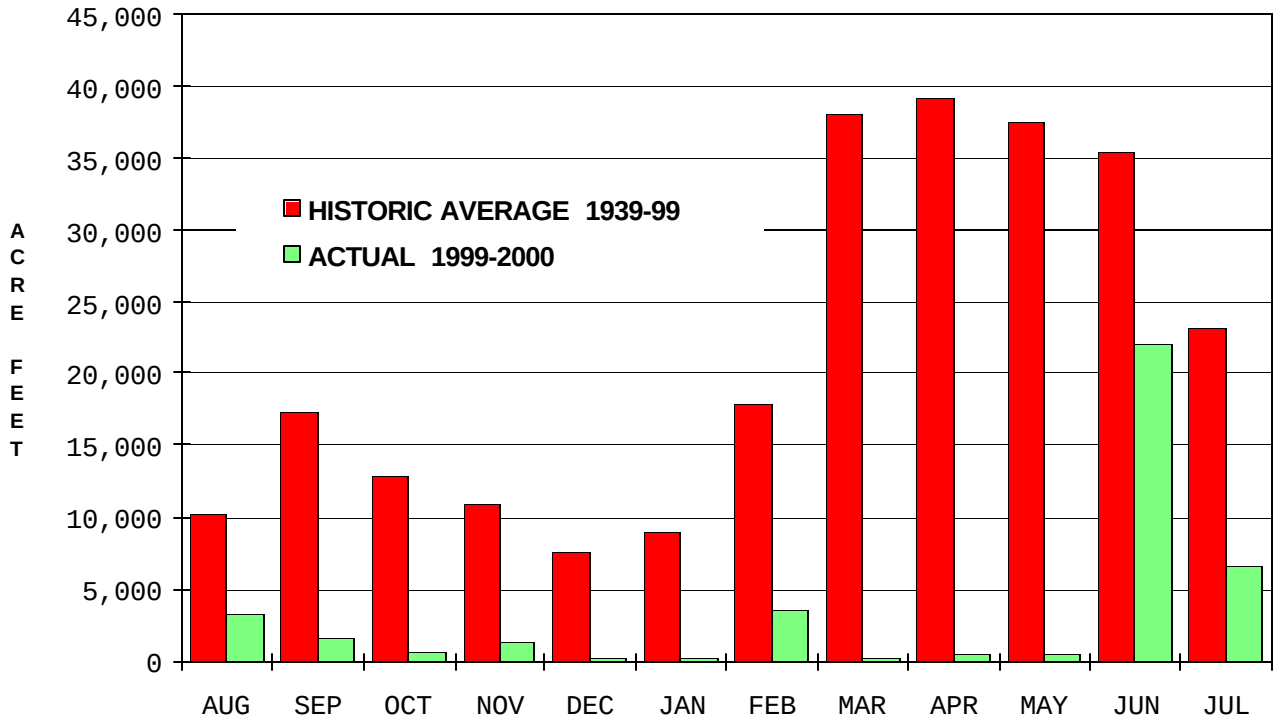


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
907.28 1 Aug 99	**904.33 31 Jul 00**	**907.28 1 Aug 99**	**902.33 10-11 Jun 00**	**927.16 28 Jul 93**	**898.38 26-27 Jan 95**

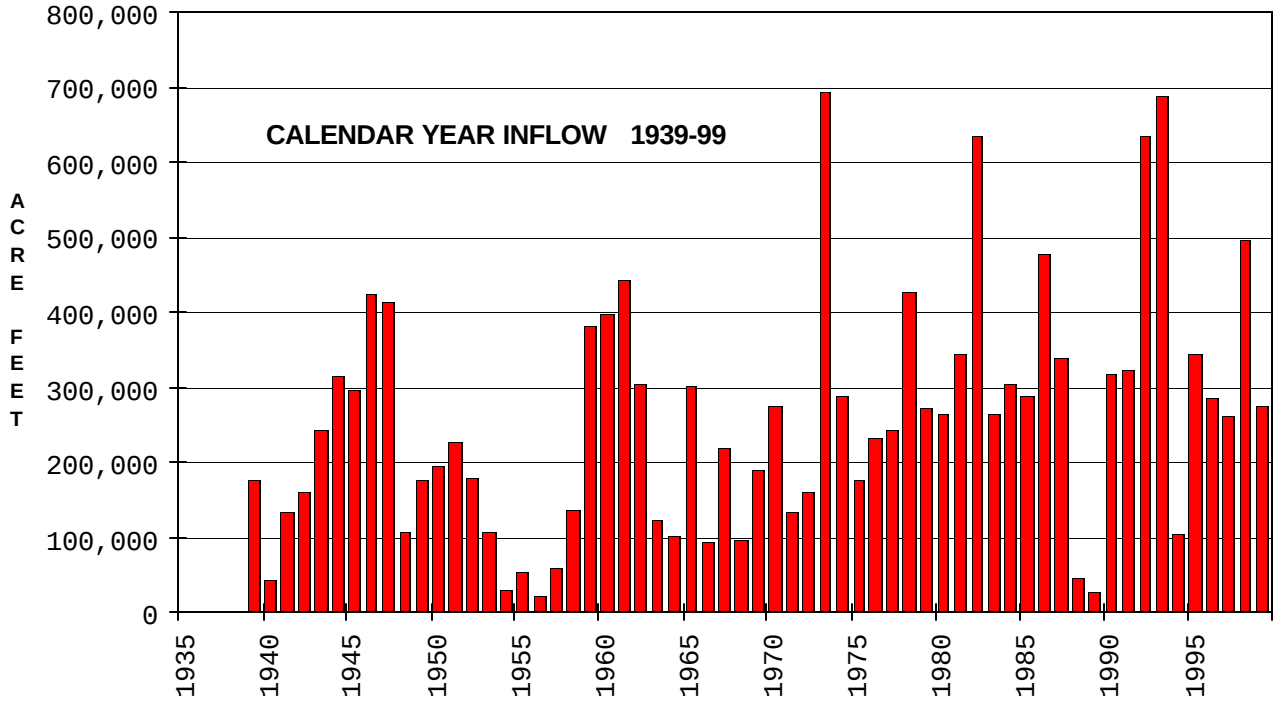
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
3,000 27 Jun 00	**40,849 374,171 AF previous period**	**1,210 1-11 Aug 99**	**20 8 Oct 99 to 10 Jul 00**

All outflows to the river. Outlets include a fish hatchery pipe and gate. Minimum release varies 15-30 cfs.

RATHBUN LAKE MONTHLY INFLOW

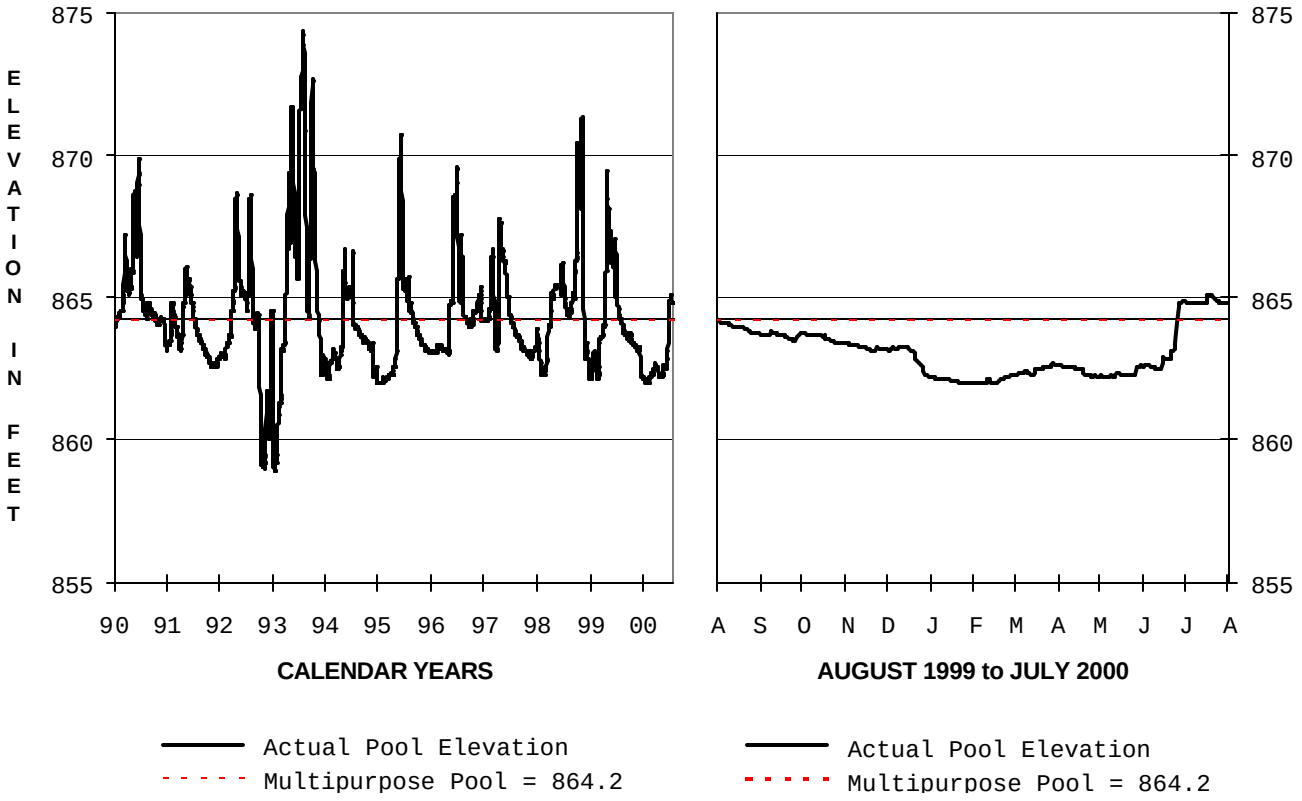


RATHBUN LAKE ANNUAL INFLOW



SMITHVILLE LAKE
1999-2000 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

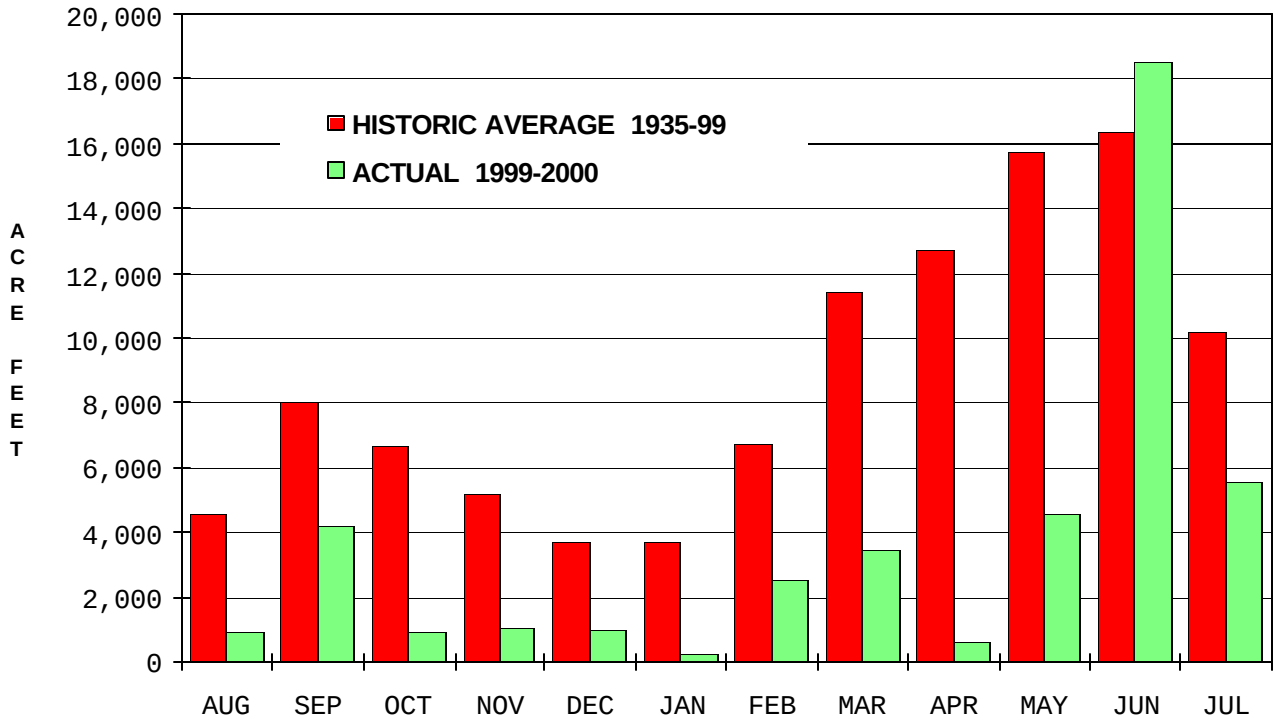


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
864.19 1 Aug 99	**864.80 31 Jul 00**	**865.12 18 Jul 00**	**861.98 7 Feb 00**	**874.31 27-28 Jul 93**	**858.86 19 Jan 93**

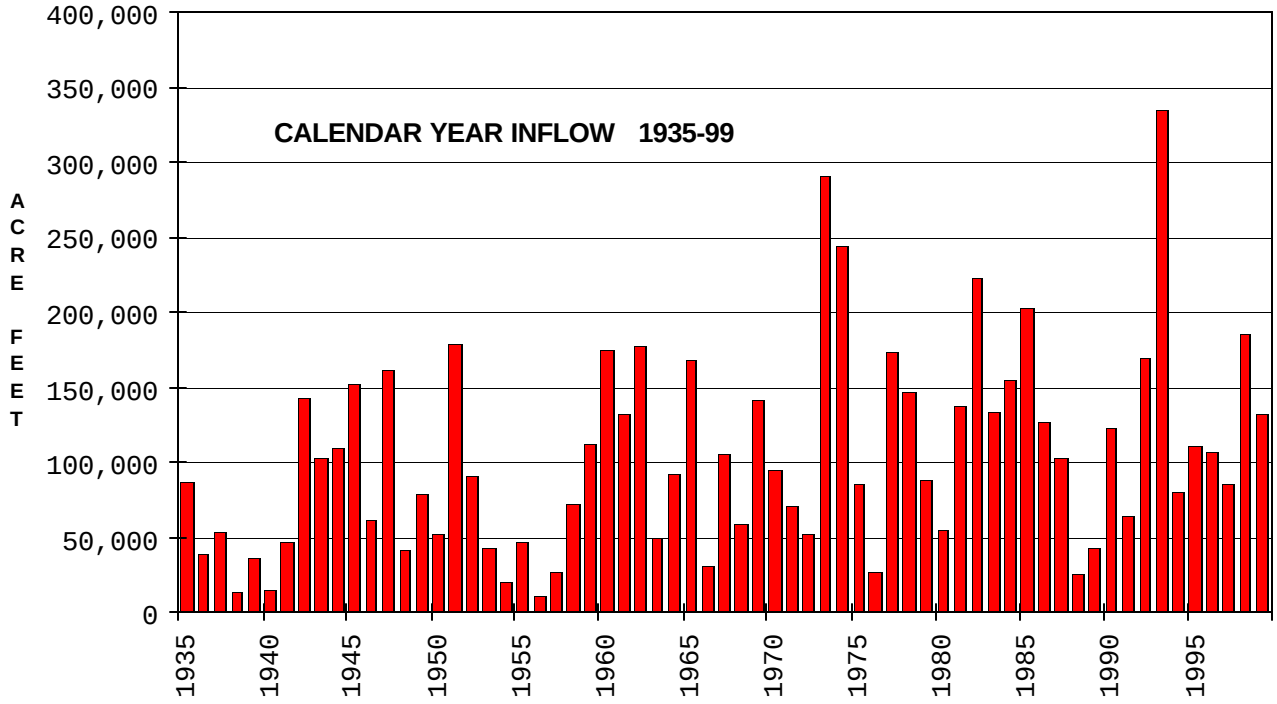
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
2,200 25 Jun 00	**43,397 254,349 AF previous period**	**469 20 Apr 00**	**8 Normal min release**

All outflows to the river. Max daily release occurred as part of a training exercise, with peaks of 500 cfs.

SMITHVILLE LAKE MONTHLY INFLOW

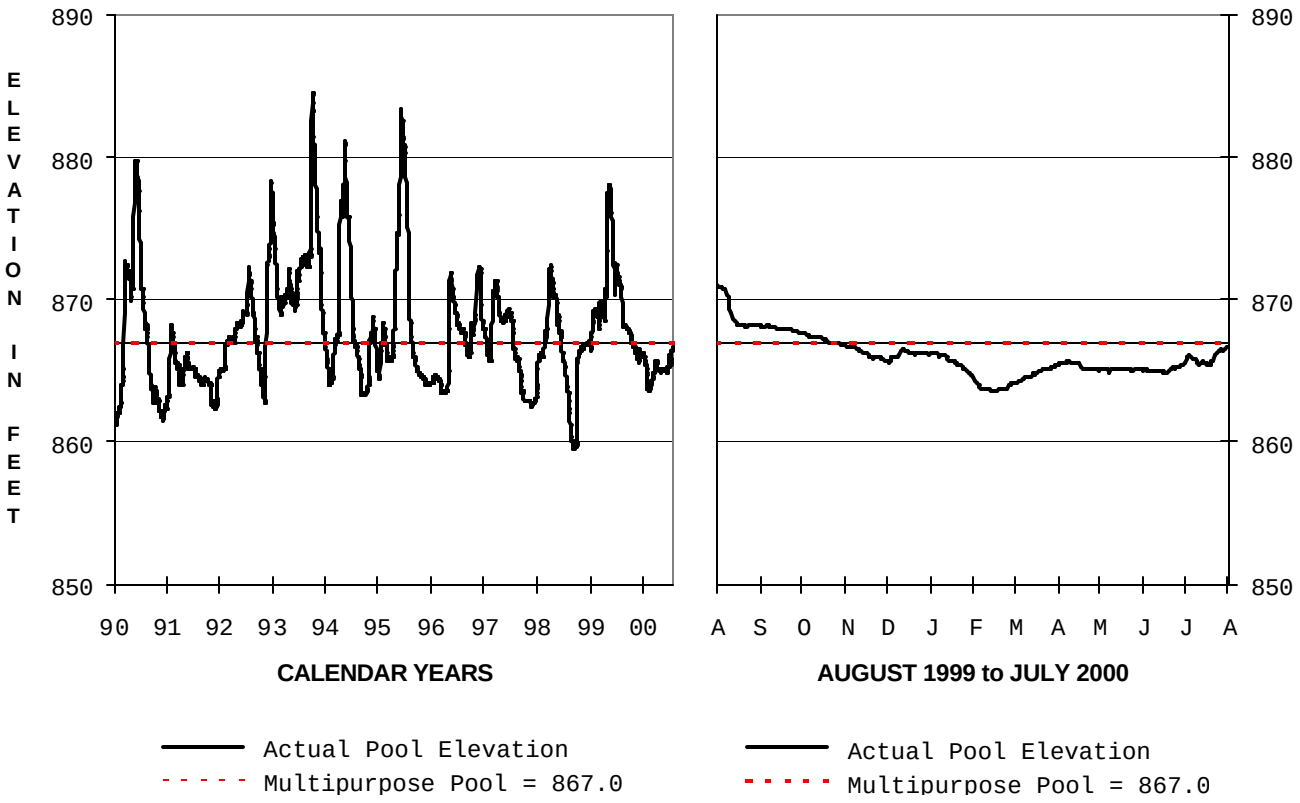


SMITHVILLE LAKE ANNUAL INFLOW



STOCKTON LAKE
1999-2000 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

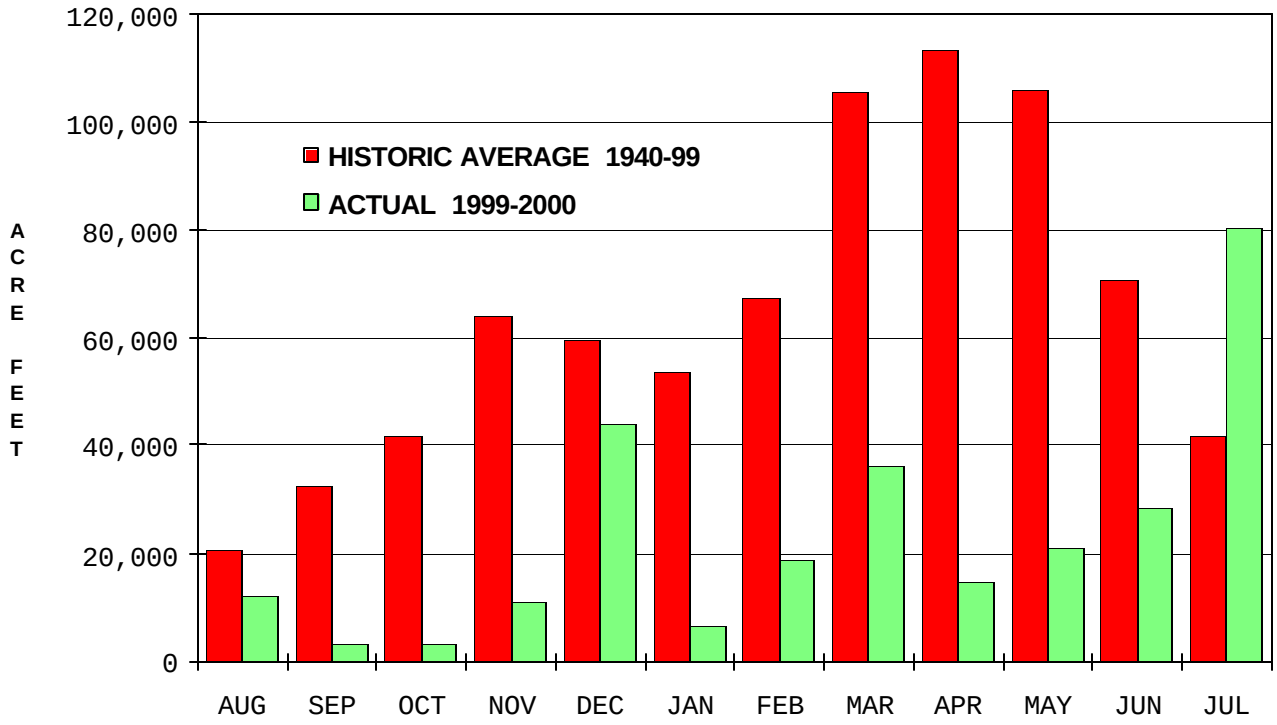


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
870.97 1 Aug 99	**866.58 31 Jul 00**	**870.97 1 Aug 99**	**863.58 15-17 Feb 00**	**885.94 28 Apr 73**	**851.86 2 Feb 77**

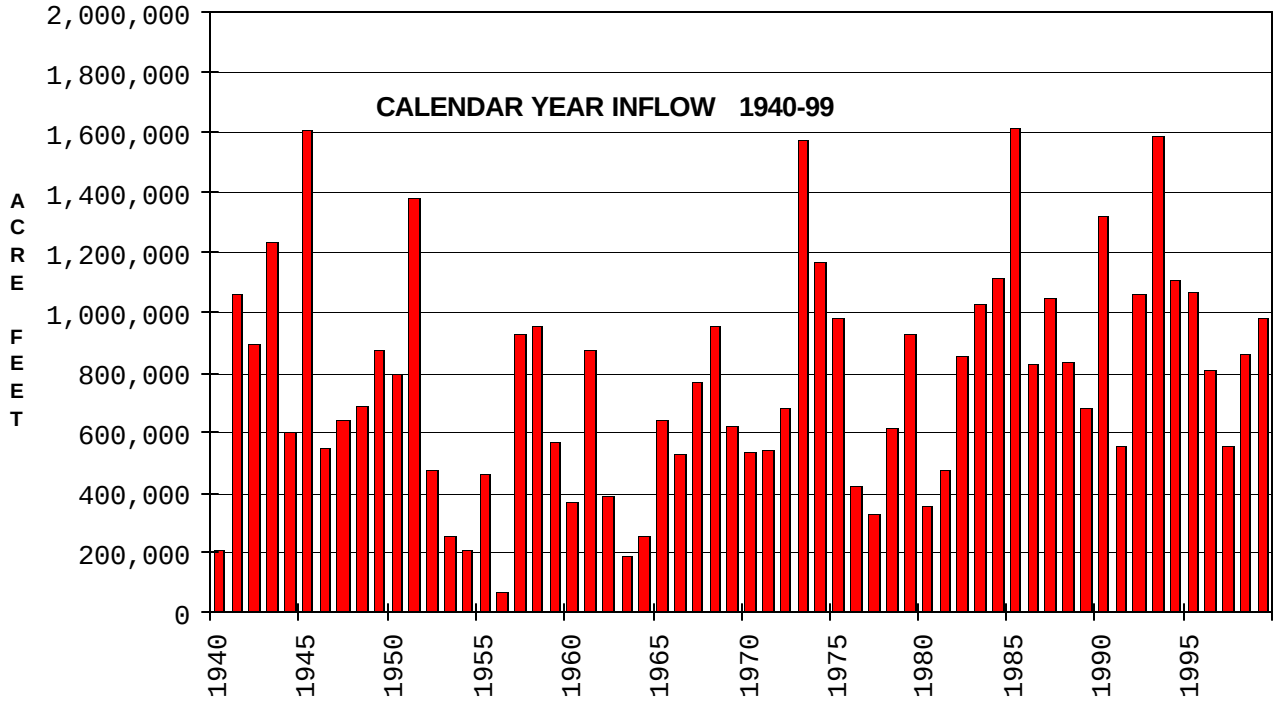
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
5,000 22 Jul 00	**280,159 1,164,326 AF previous period**	**5,040 10-11 Aug 99**	**40 Normal min release**

Max daily outflow includes turbine releases and spill to the river. Spill required when not generating.

STOCKTON LAKE MONTHLY INFLOW

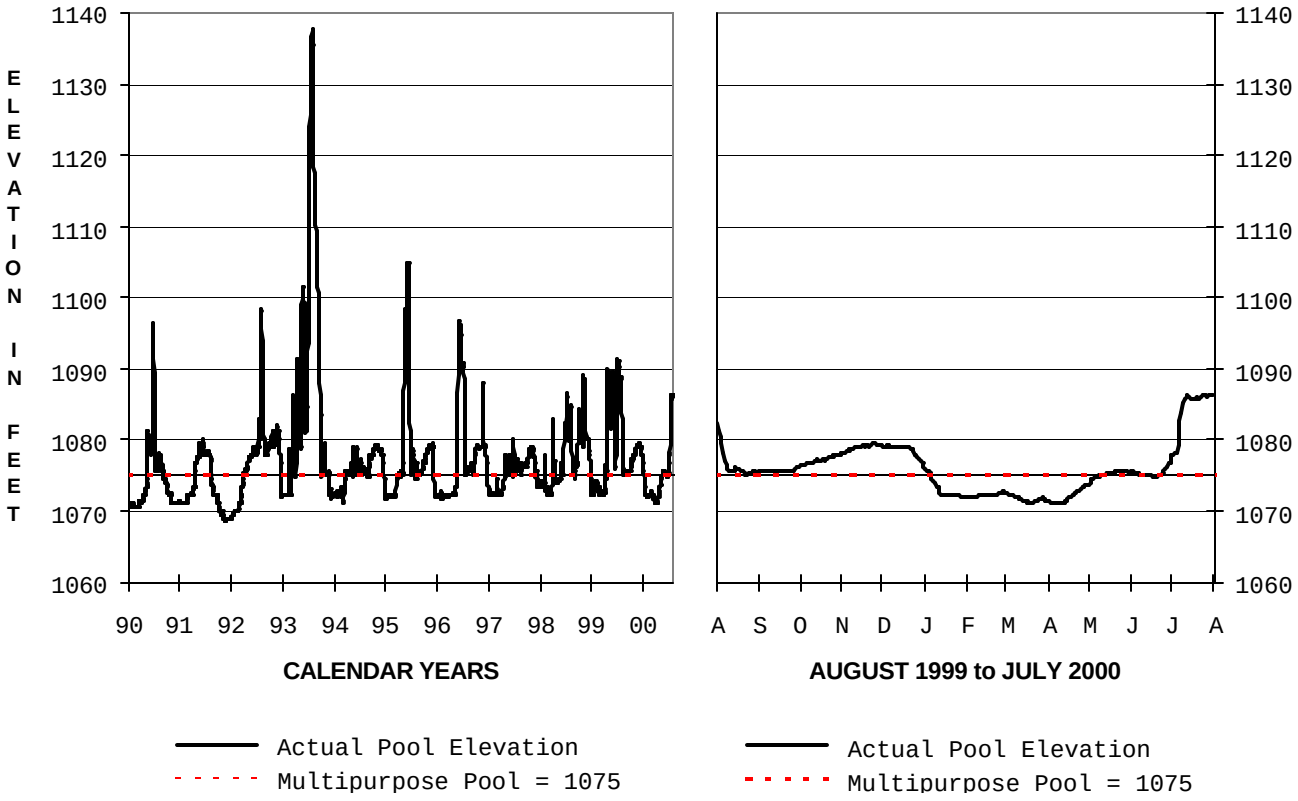


STOCKTON LAKE ANNUAL INFLOW



TUTTLE CREEK LAKE
1999-2000 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

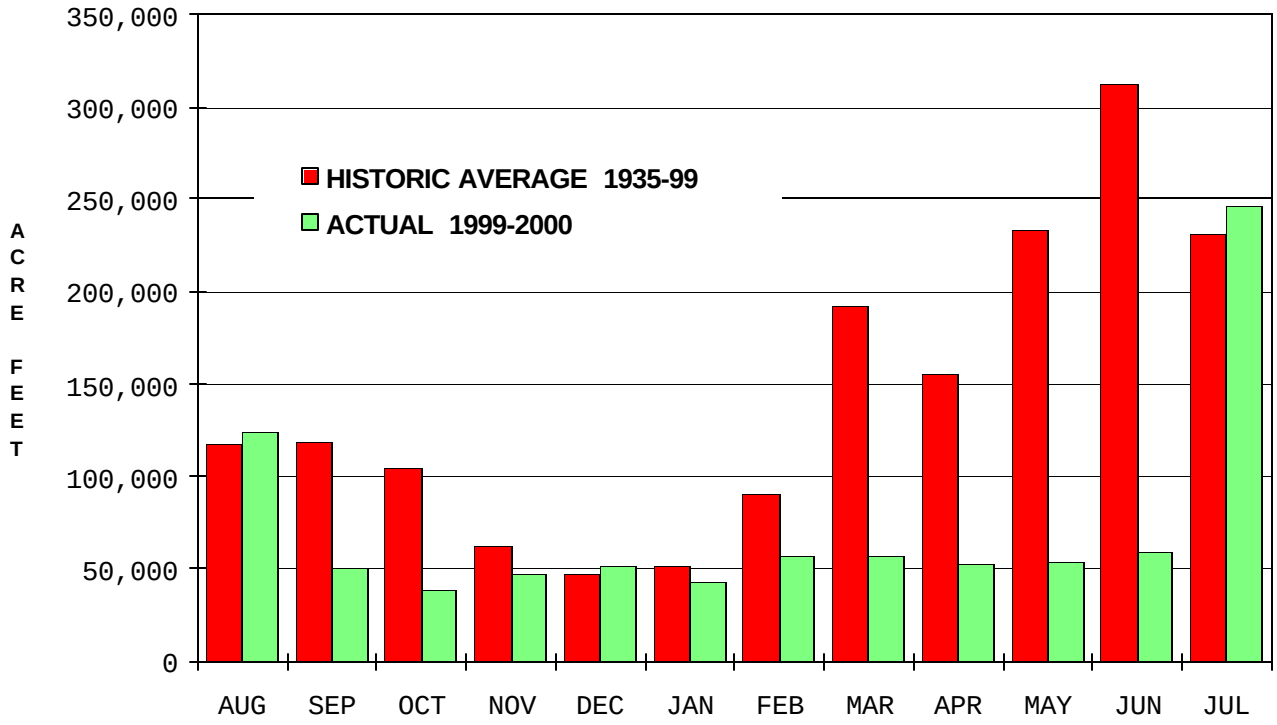


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1082.14 1 Aug 99	**1086.34 31 Jul 00**	**1086.37 29 Jul 00**	**1071.03 5 Apr 00**	**1137.76 22 Jul 93**	**1060.93 2-3 Jan 67**

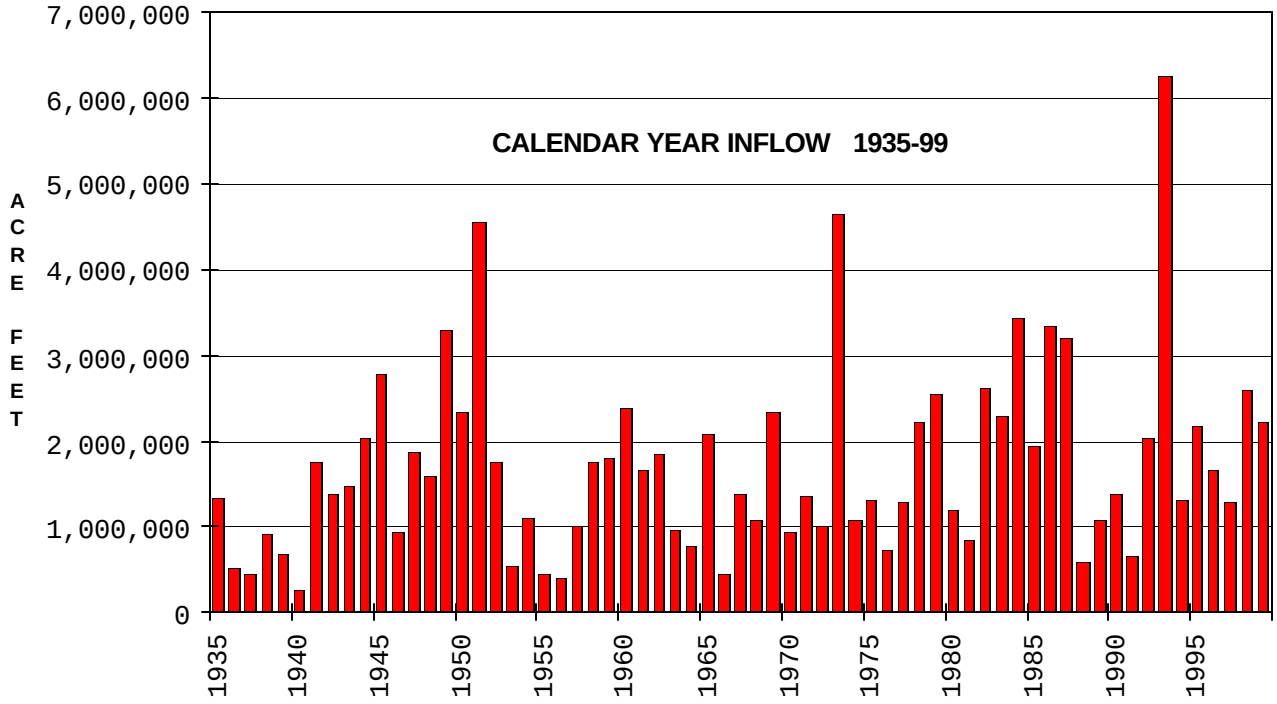
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
17,000 6 Jul 00	**880,926 2,850,226 AF previous period**	**10,000 1-5 Aug 99**	**44 21 Jun 00**

Outflows cut to 0 for short times during nesting season May to Aug. Normal minimum releases 100 cfs.

TUTTLE CREEK LAKE MONTHLY INFLOW

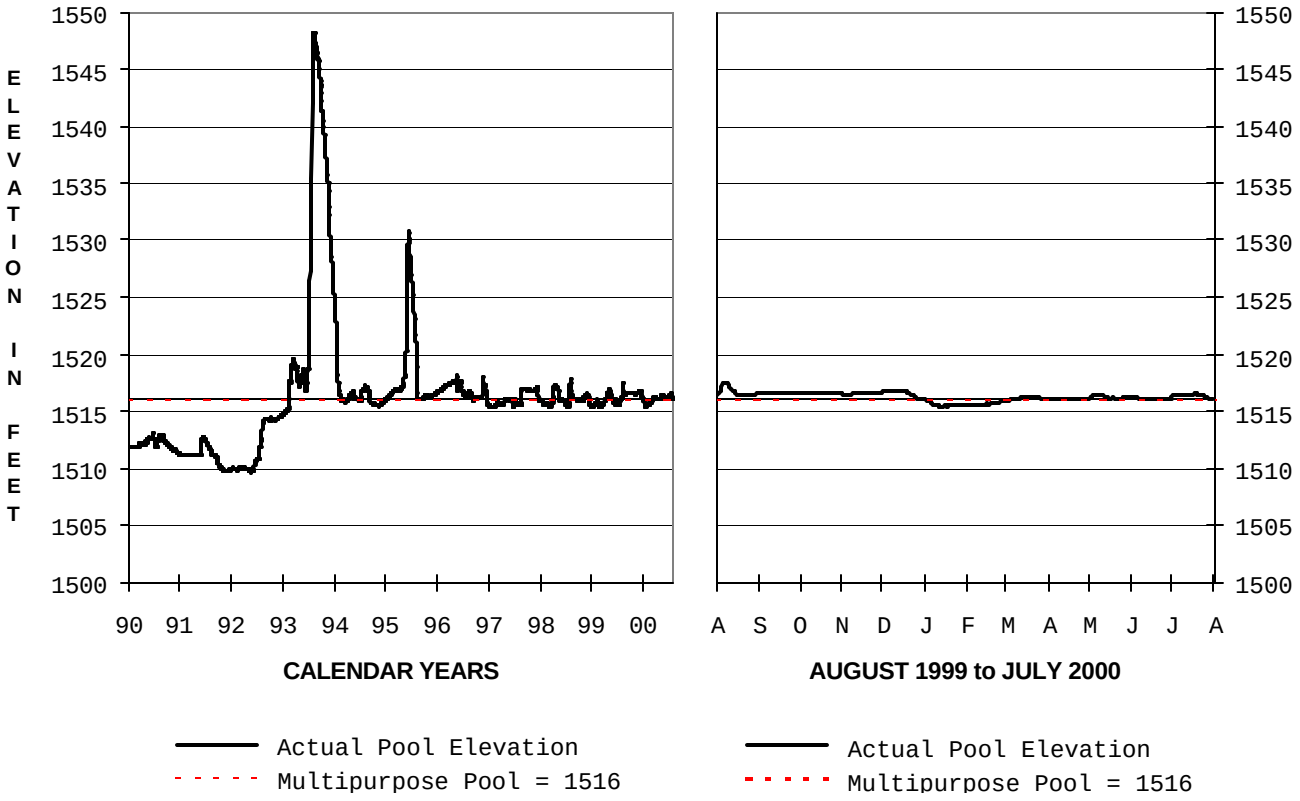


TUTTLE CREEK LAKE ANNUAL INFLOW



WILSON LAKE
1999-2000 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

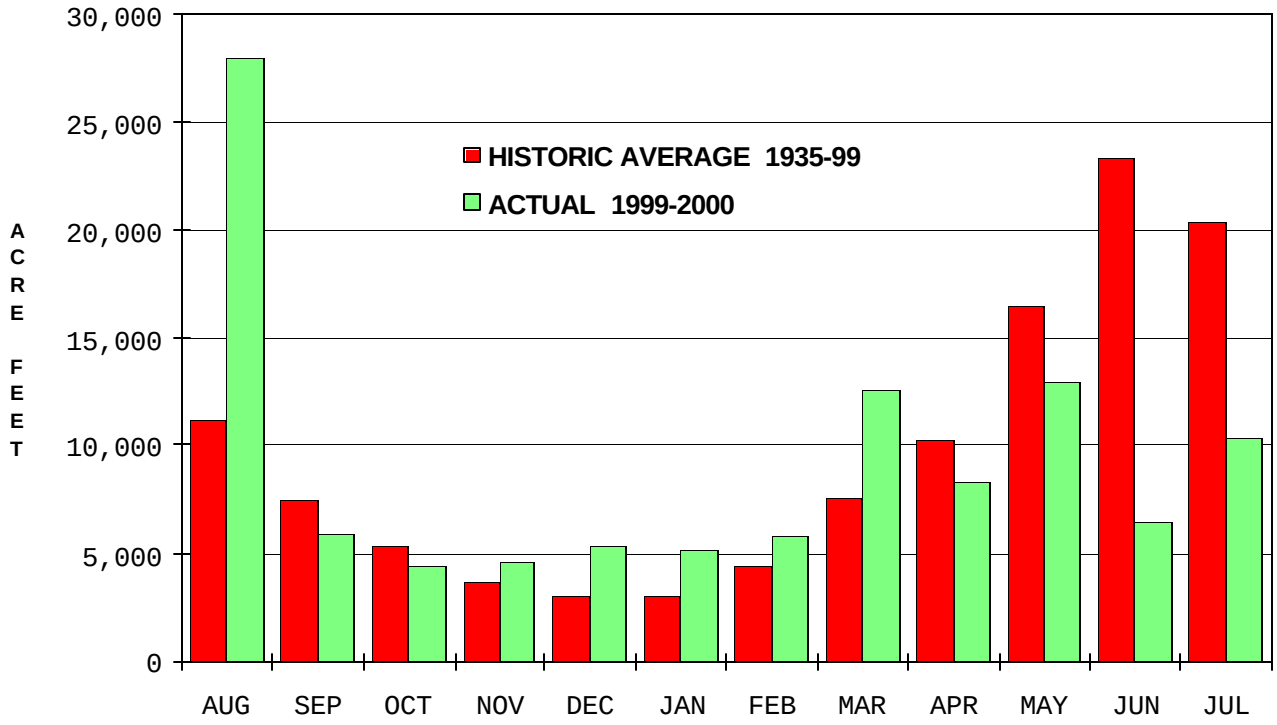


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1516.43 1 Aug 99	**1516.09 31 Jul 00**	**1517.49 6 Aug 99**	**1515.49 11-13 Jan 00**	**1548.27 13 Aug 93**	**1509.62 27 May 92**

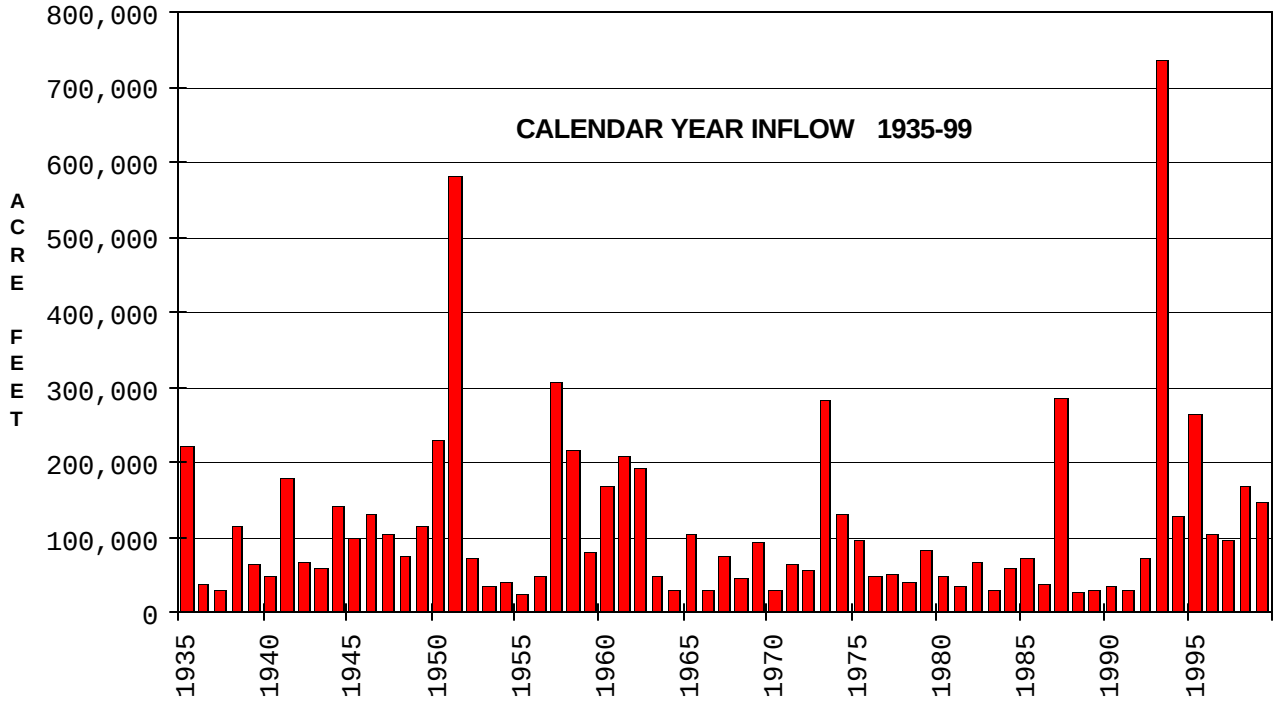
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
1,750 4 Aug 99	**109,715 135,331 AF previous period**	**1,000 5-13 Aug 99**	**1 4 Aug 99**

Outflow cut to 0 for inspection 3-4 Aug 99, other short times for maintenance. Normal minimum 5-15 cfs.

WILSON LAKE MONTHLY INFLOW



WILSON LAKE ANNUAL INFLOW



APPENDIX B
BUREAU OF RECLAMATION PROJECTS

BONNY RESERVOIR

CEDAR BLUFF RESERVOIR

ENDERS RESERVOIR

HARRY STRUNK LAKE
(Medicine Creek Dam)

HUGH BUTLER LAKE
(Red Willow Dam)

KEITH SEBELIUS LAKE
(Norton Dam)

KIRWIN RESERVOIR

LOVEWELL RESERVOIR

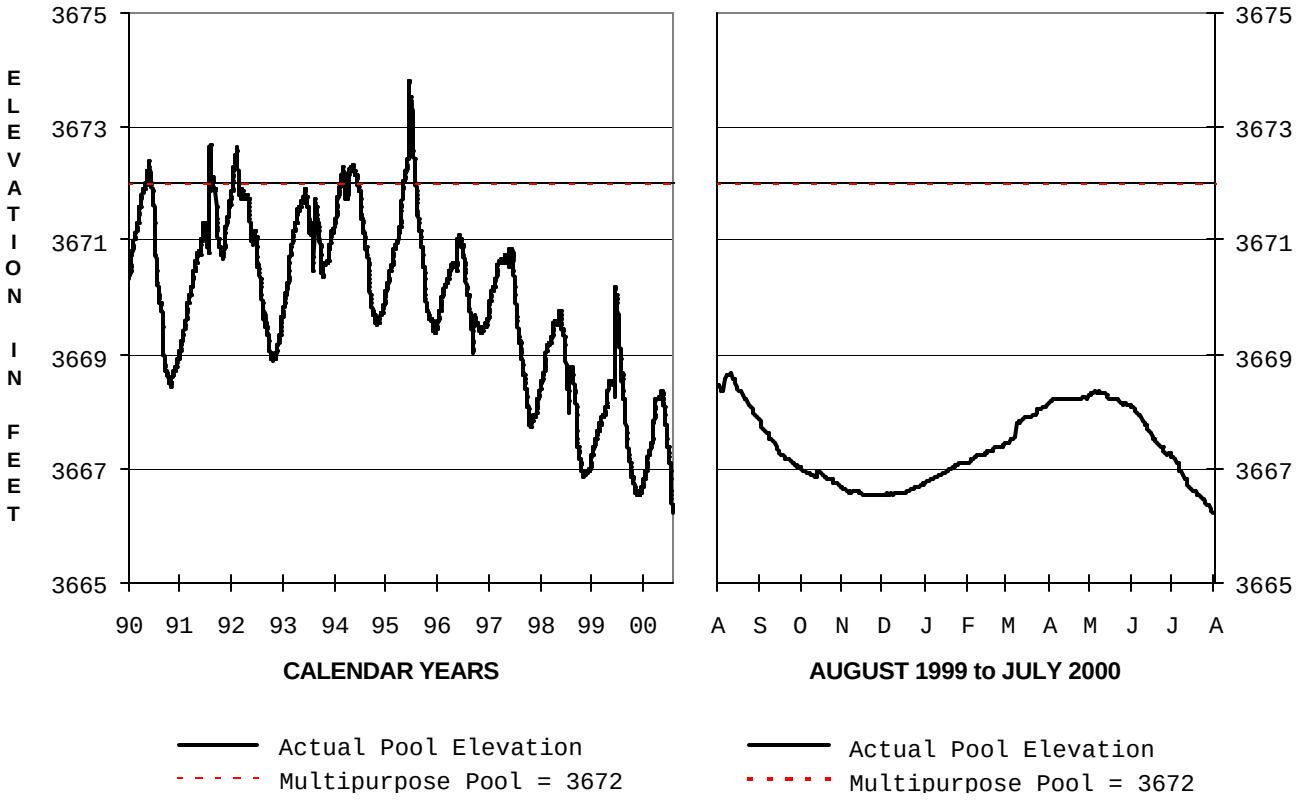
SWANSON LAKE
(Trenton Dam)

WACONDA LAKE
(Glen Elder Dam)

WEBSTER RESERVOIR

BONNY RESERVOIR
1999-2000 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



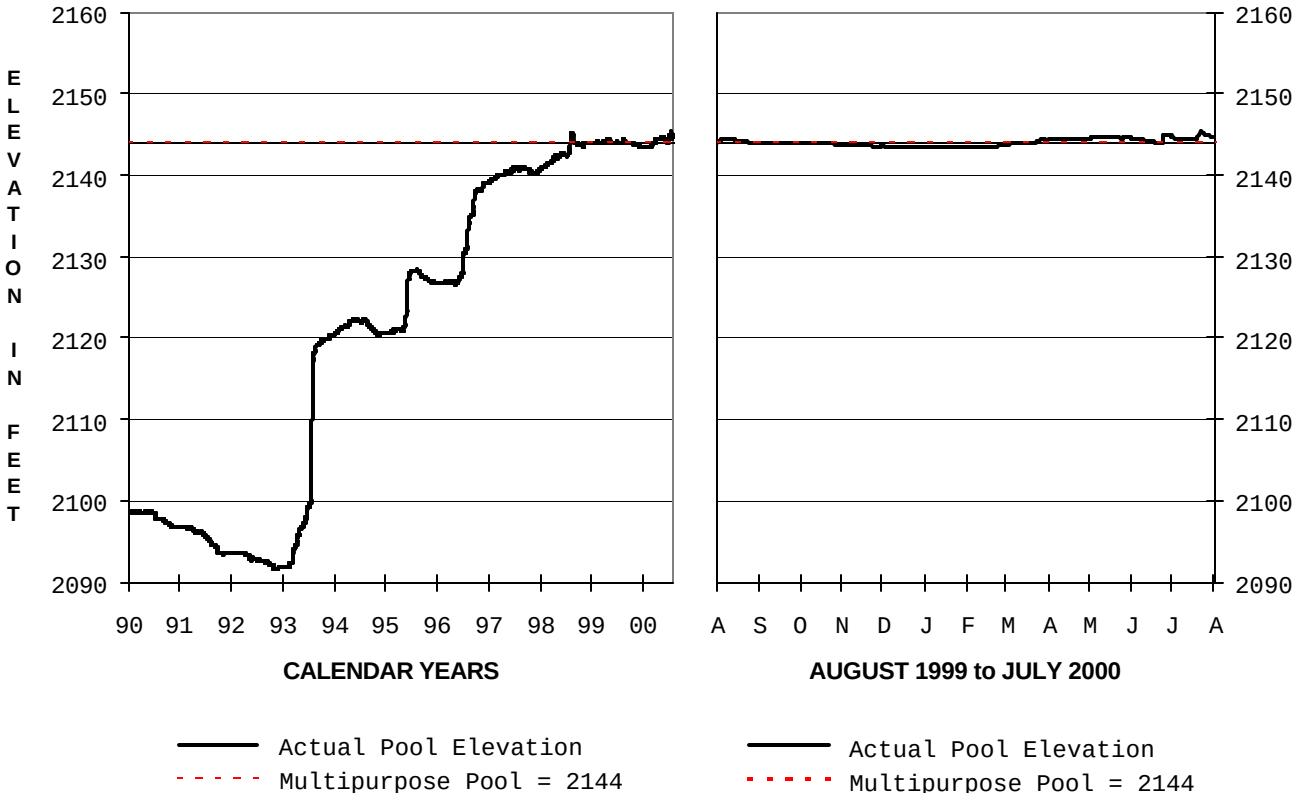
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
3668.34 1 Aug 99	**3666.22 31 Jul 00**	**3668.67 11 Aug 99**	**3666.22 31 Jul 00**	**3678.10 17 May 57**	**3661.97 4 Jun 65**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
150 6 Aug 99	**11,375 15,473 AF previous period**	**8 1 Aug to 23 Sep 99**	**6 24 Sep 99 and after**

Maximum daily outflow is the river release only. Most releases were to the irrigation canal.

CEDAR BLUFF RESERVOIR
1999-2000 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



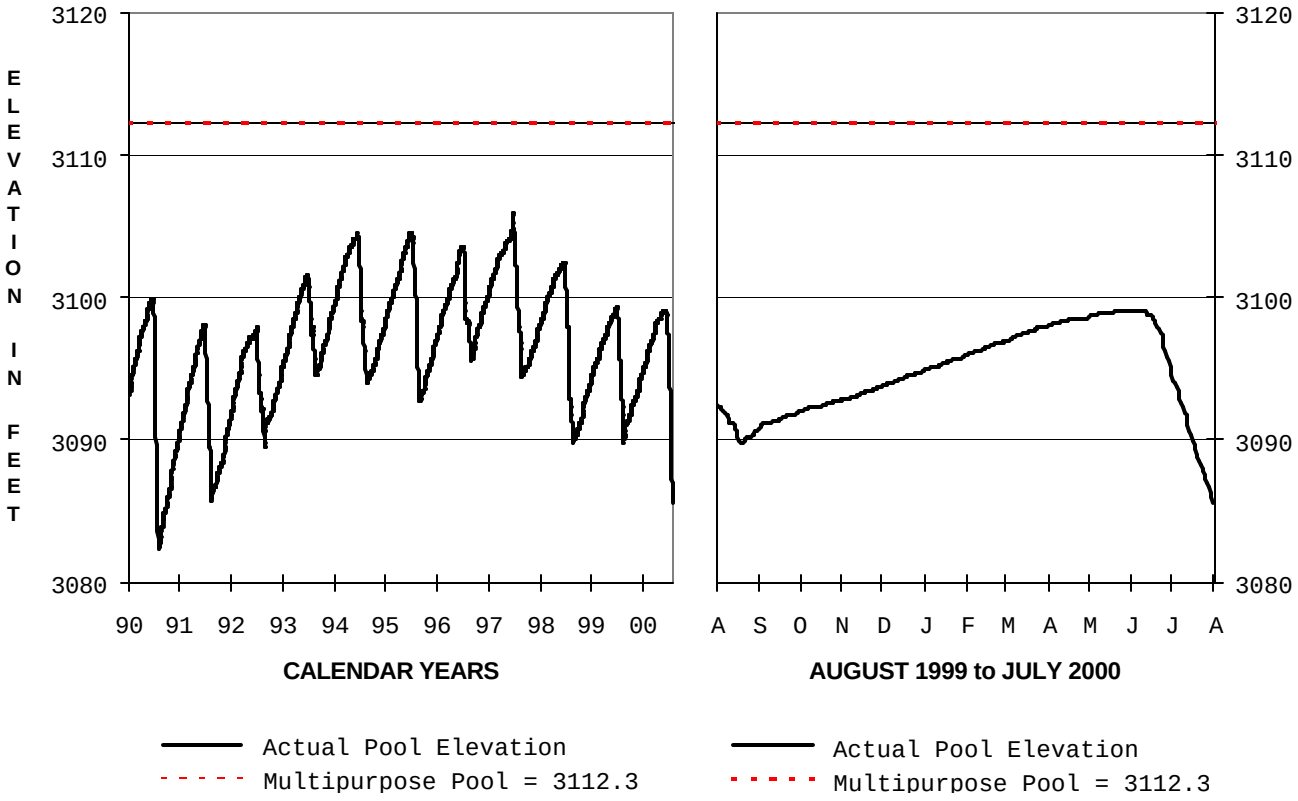
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
2144.05 1 Aug 99	**2144.68 31 Jul 00**	**2145.36 22 Jul 00**	**2143.47 26-27 Jan 00**	**2154.90, 2 Jul 51 4-5 Jul 57**	**2091.78 9-19 Nov 92**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
1,600 24 Jun 00	**45,565 51,392 AF previous period**	**300, on 27 Jun to 3 Jul and 21 Jul to 1 Aug 00**	**0 Normal min release**

Maximum daily outflow is the river release only. Small releases were also made to the fish hatchery.

ENDERS RESERVOIR
1999-2000 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



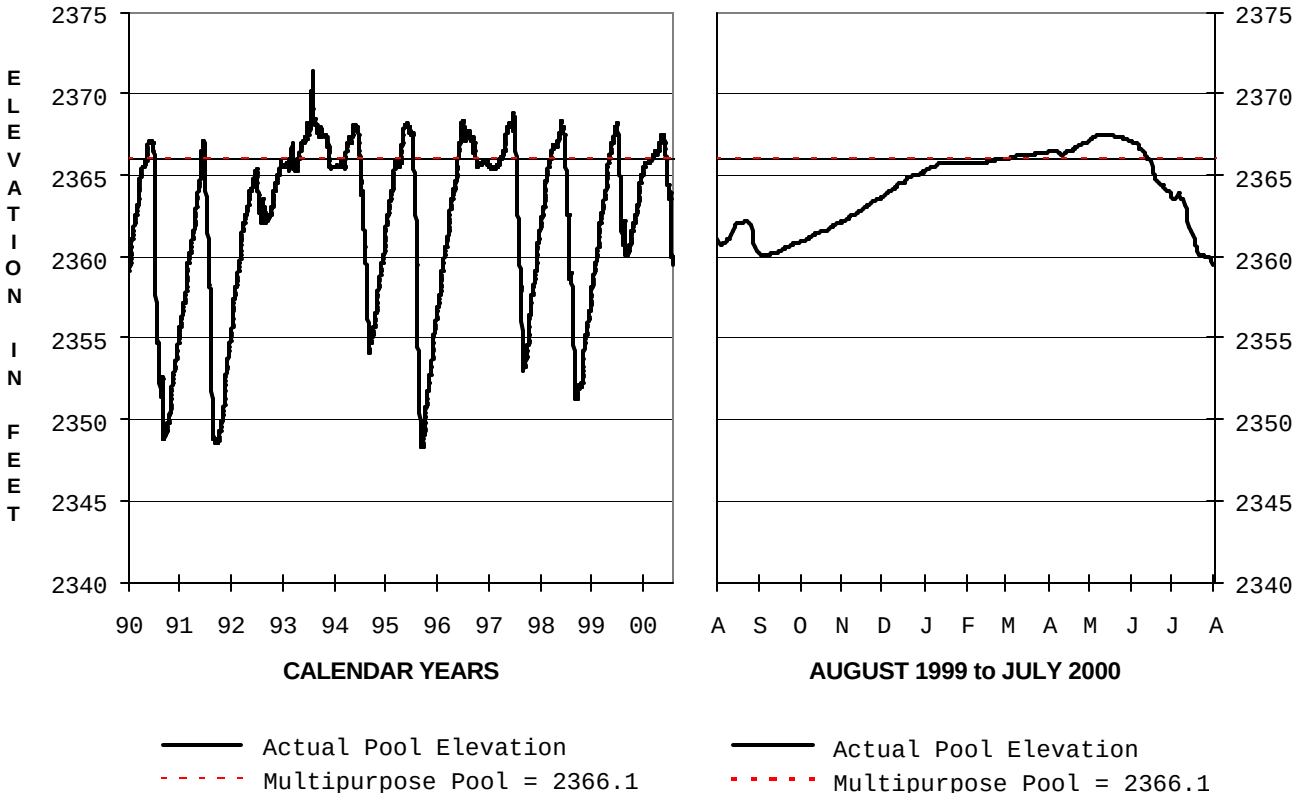
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
3092.44 1 Aug 99	**3085.63 31 Jul 00**	**3099.10 1 Jun 00**	**3085.63 31 Jul 00**	**3118.20 25 Mar 60**	**3080.67 28 Aug 78**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
155 11 Aug 99	**14,995 15,769 AF previous period**	**225 26-27 Jun 00**	**1 Normal min release**

The maximum daily outflow occurred as part of normal releases during the irrigation season.

HARRY STRUNK LAKE
1999-2000 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



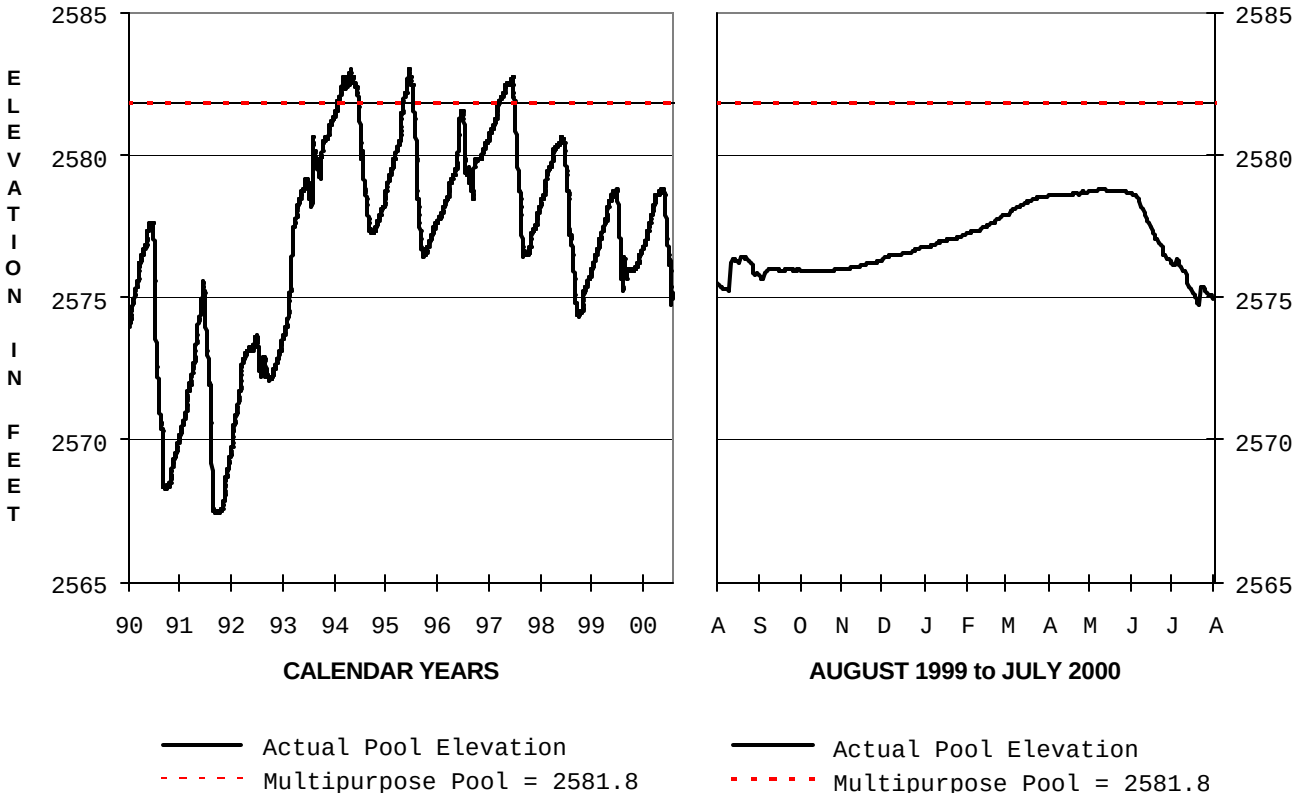
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
2361.07 1 Aug 99	**2359.51 31 Jul 00**	**2367.56 9 May 00**	**2359.51 31 Jul 00**	**2374.10 23 Mar 60**	**2340.42 8 Sep 78**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
300 12 Aug 99	**37,018 37,468 AF previous period**	**302 31 Jul 00**	**1, most of the year when not irrigating**

The maximum daily outflow occurred as part of normal releases during the irrigation season.

HUGH BUTLER LAKE
1999-2000 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



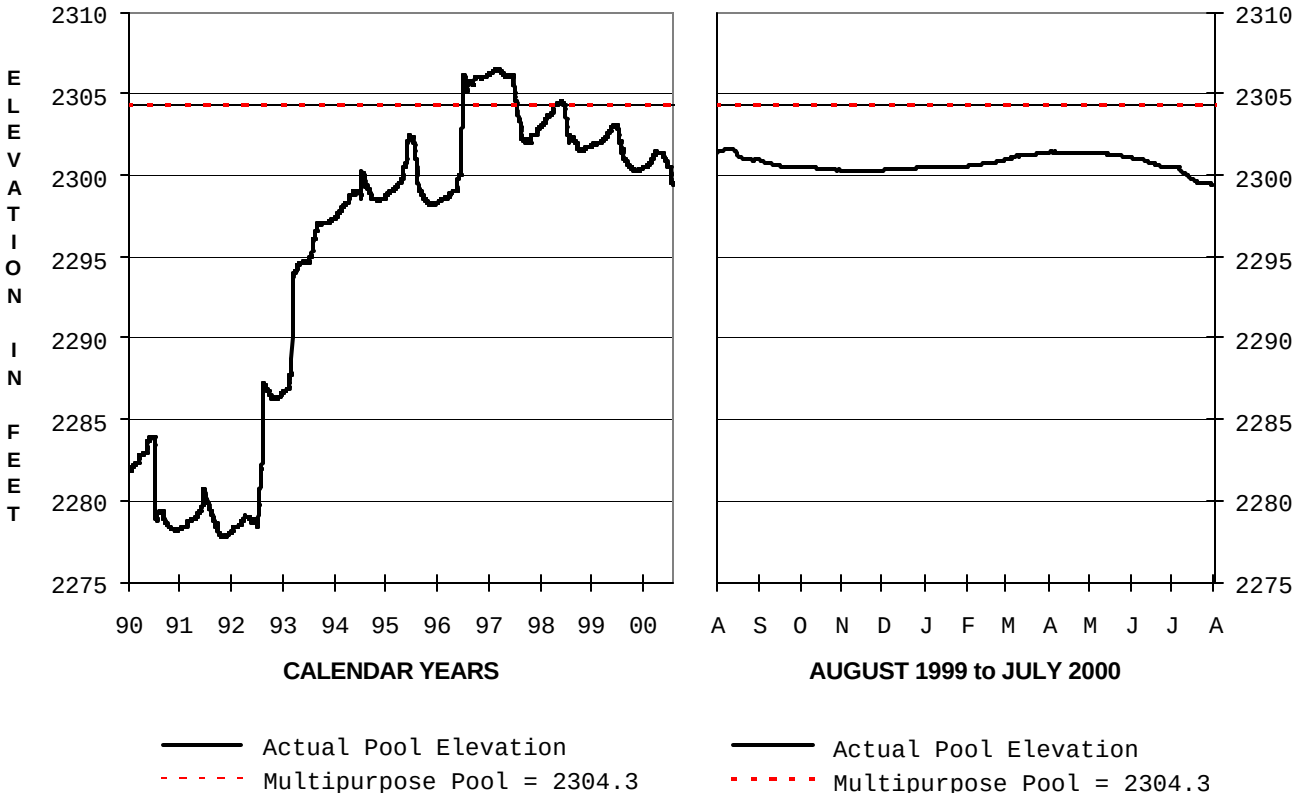
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
2575.51 1 Aug 99	**2574.96 31 Jul 00**	**2578.82 8-9 May 00**	**2574.74 21 Jul 00**	**2584.11 16 Jul 67**	**2565.28 9 Sep 78**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
600 11 Aug 99	**16,661 15,015 AF previous period**	**104 25-29 Aug 99**	**4, most of the year when not irrigating**

The maximum daily outflow occurred as part of normal releases during the irrigation season.

KEITH SEBELIUS LAKE
1999-2000 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



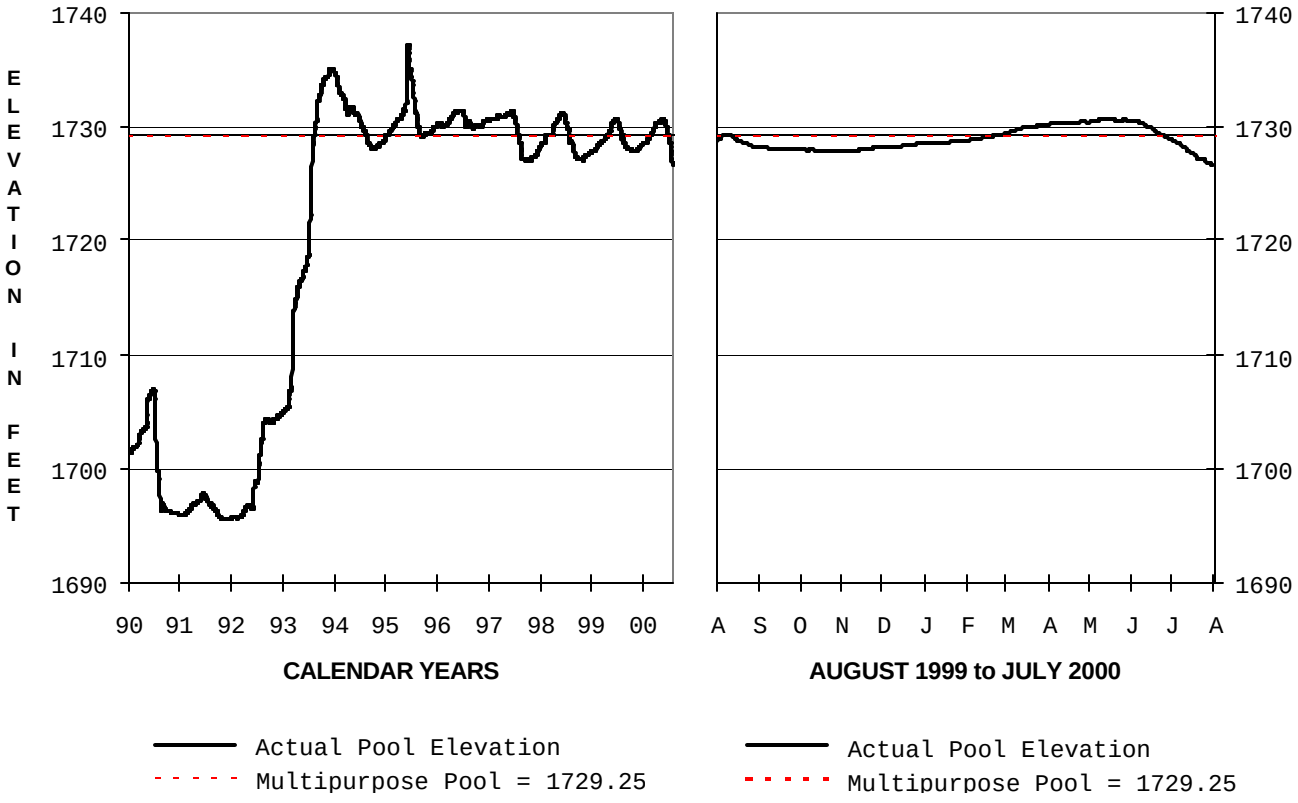
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
2301.30 1 Aug 99	**2299.37 31 Jul 00**	**2301.67 8-9 Aug 99**	**2299.37 31 Jul 00**	**2306.47 15 Feb to 4 Mar 97**	**2275.82 28-29 Nov 81**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
125 2 Aug 99	**8,950 10,123 AF previous period**	**80, 13-14 Aug 99, and 20-22 Jun 00**	**0, several periods. Normal min 1 cfs**

Max outflow occurred with irrigation. Historic minimum elevation also occurred on 20 Jan to 1 Feb 82.

KIRWIN RESERVOIR
1999-2000 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



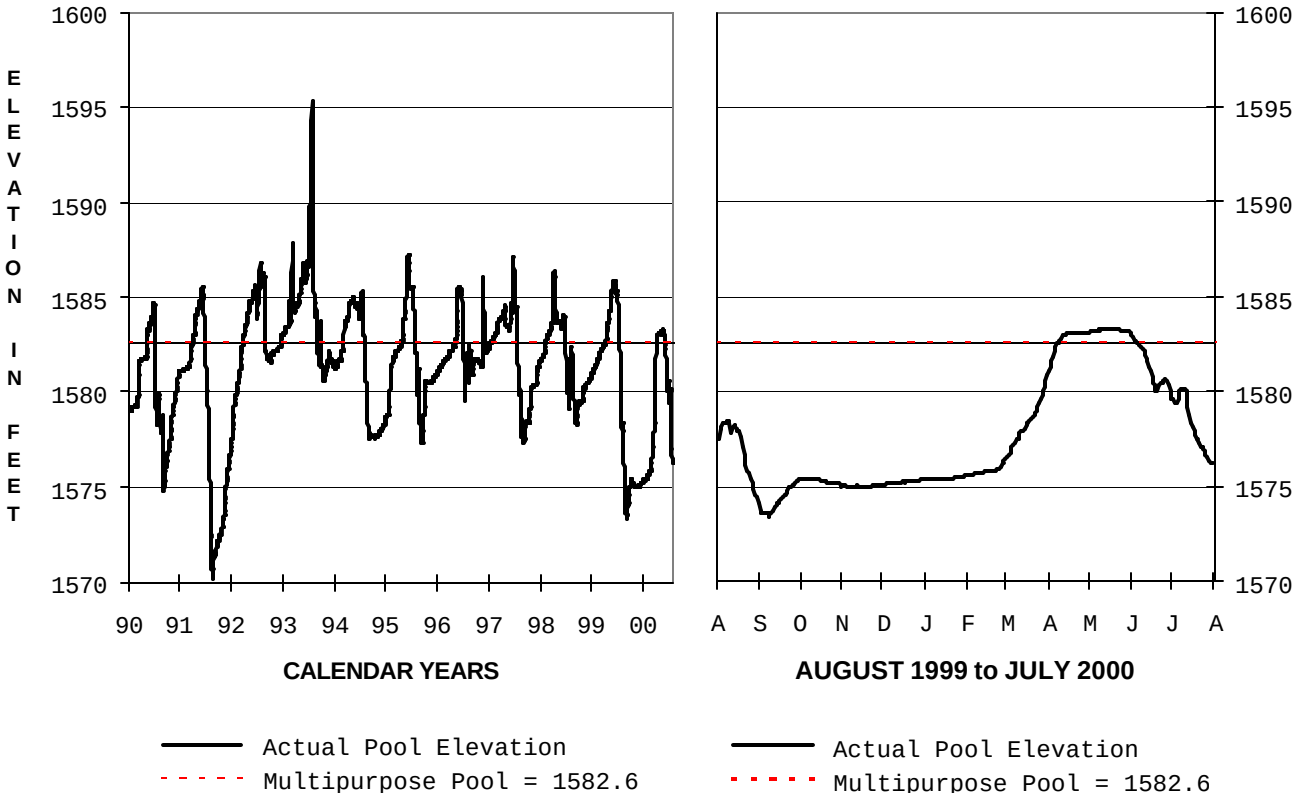
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1728.78 1 Aug 99	**1726.60 31 Jul 00**	**1730.55 11-12 May 00**	**1726.60 31 Jul 00**	**1737.07 2 Jun 95**	**1695.45 11 Feb 81**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
600 2 Aug 99	**33,253 38,231 AF previous period**	**0 Entire year**	**0 Entire year**

Maximum daily outflow is the river release only. All releases this year were made to the irrigation canal.

LOVEWELL RESERVOIR
1999-2000 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



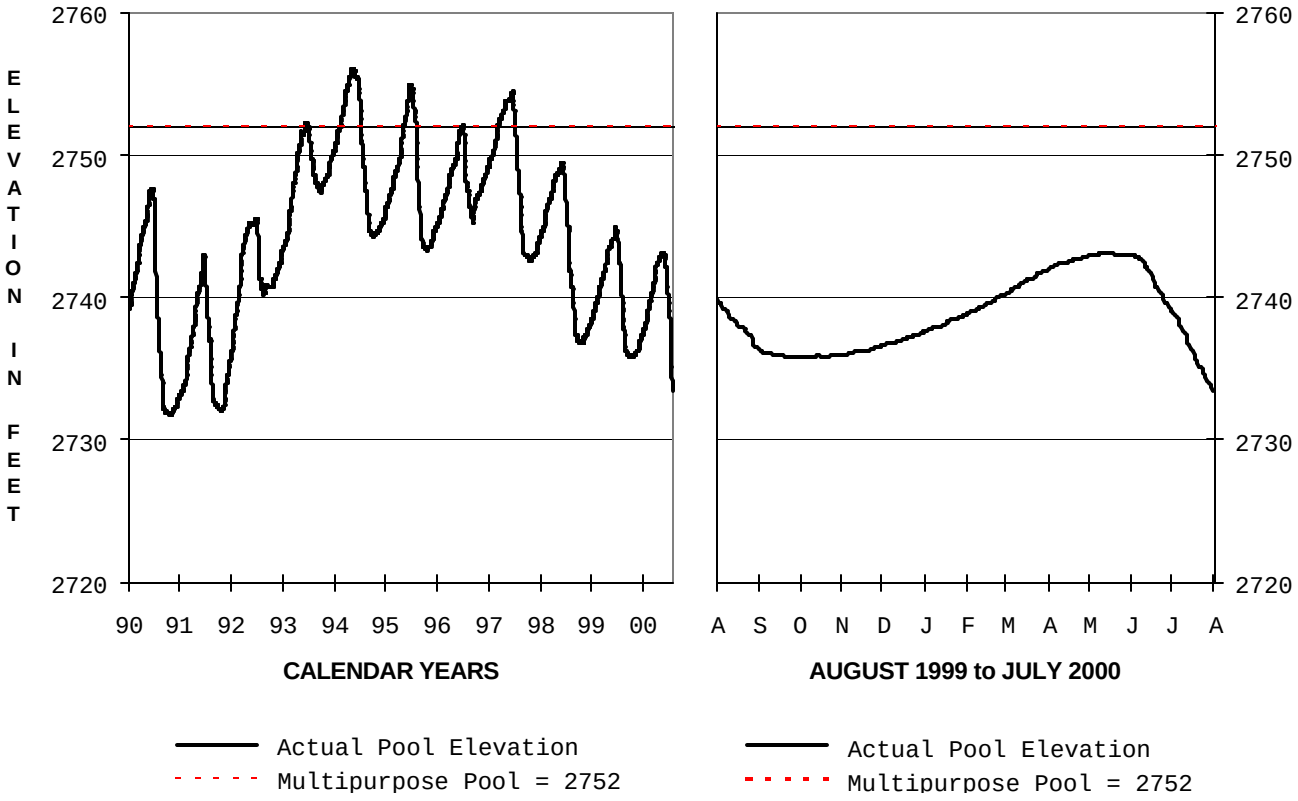
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1577.63 1 Aug 99	**1576.24 31 Jul 00**	**1583.28 12 May 00**	**1573.41 8 Sep 99**	**1595.34 22 Jul 93**	**1570.20 22 Aug 91**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
Not Available	**Not Available**	**0 Entire year**	**0 Entire year**

Maximum daily outflow is the river release only. All releases this year were made to the irrigation canal.

SWANSON LAKE
1999-2000 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



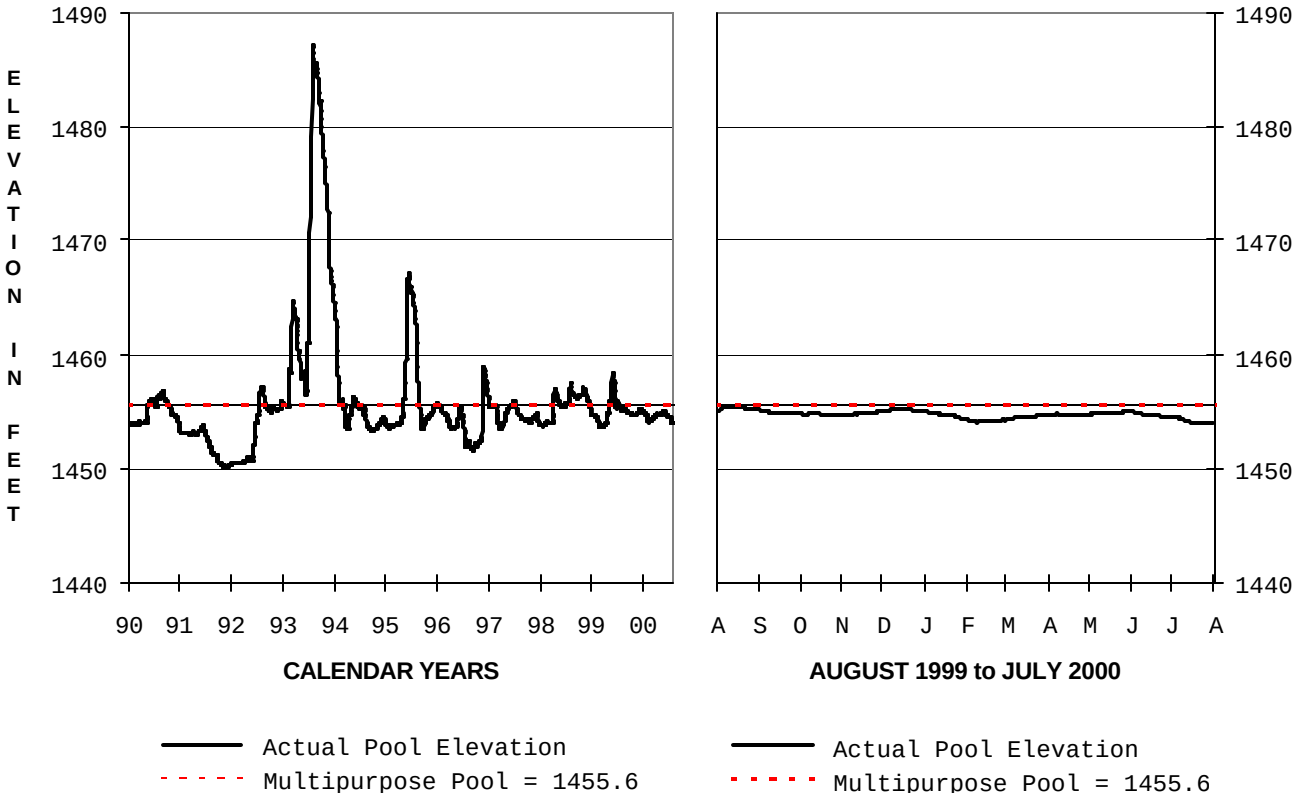
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
2739.85 1 Aug 99	**2733.50 31 Jul 00**	**2743.16 11 May 00**	**2733.50 31 Jul 00**	**2757.40 3-4 Aug 62**	**2725.90 16-18 Nov 76**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
250 18 Aug 99	**38,496 43,994 AF previous period**	**200 9-11 Jun 00**	**1, most of the year when not irrigating**

Maximum daily outflow is the river release only. Releases were also made to the irrigation canal.

WACONDA LAKE
1999-2000 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



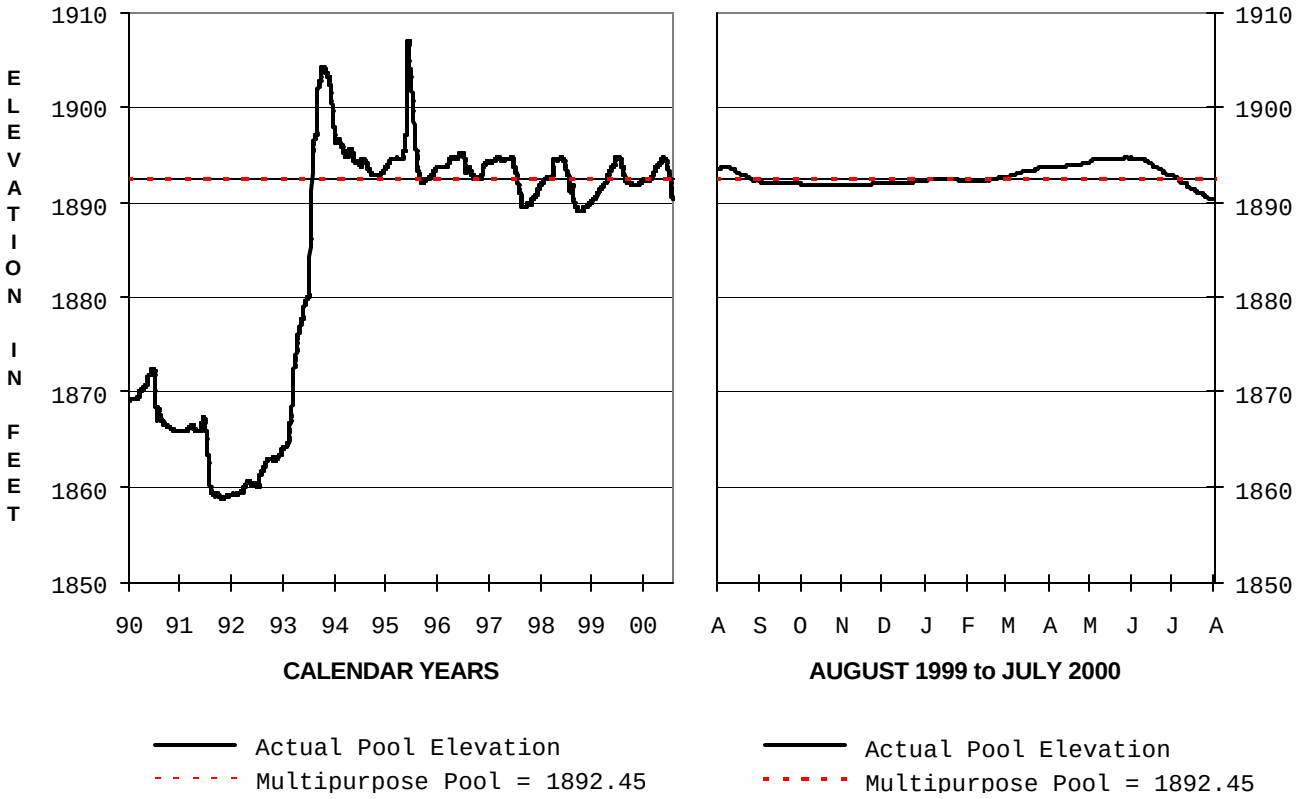
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1454.96 1 Aug 99	**1453.89 31 Jul 00**	**1455.41 12-13 Aug 99**	**1453.89 31 Jul 00**	**1487.02 29 Jul 93**	**1448.90 6-7 Dec 84**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
975 24 Mar 00	**116,253 251,085 AF previous period**	**300 10 Jan to 8 Feb 00**	**20, 10-17 Sep 99 and 24-30 May 00**

The maximum daily outflow is the river release only.

WEBSTER RESERVOIR
1999-2000 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1893.51 1 Aug 99	**1890.30 31 Jul 00**	**1894.75 27-31 May 00**	**1890.30 31 Jul 00**	**1907.04 5 Jun 95**	**1857.35 22-29 Oct 71**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
330 3 Mar 00	**29,626 33,442 AF previous period**	**190 20 Jun 00**	**0, most of the year when not irrigating**

The maximum daily outflow occurred as part of normal releases during the irrigation season.